VOLUME 40
NUMBER 9

SEPTEMBER, 1953

plating

CHROMIUM PLATING SYMPOSIUM

See Contents Page 979

POSTMASTER: IF UNDELIVERABLE RETURN TO
5800 N. MARVINE ST., PHILADELPHIA 41, PA.
RETURN POSTAGE GUARANTEED

University Microfilms
313 N. First St.
Ann Arbor, Michigan

Clepo-Phos

CLEPO 196
CLEPO 196-F

Insures **GOOD PAINT ADHESION . . .**
Prevents **CORROSION** *of the base metal*

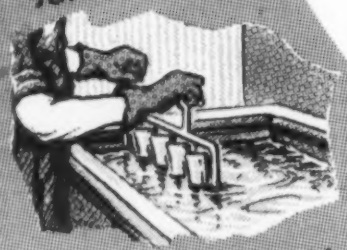
A simple economical process for the cleaning and preparation of steel for painting

Clepo 196 for Tank Dipping

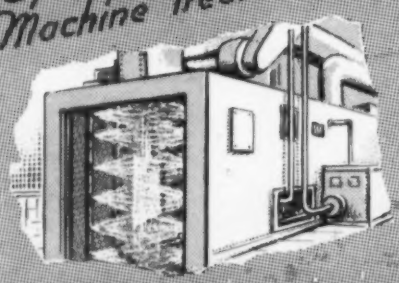
Clepo 196-F for spray washing machine treatment.

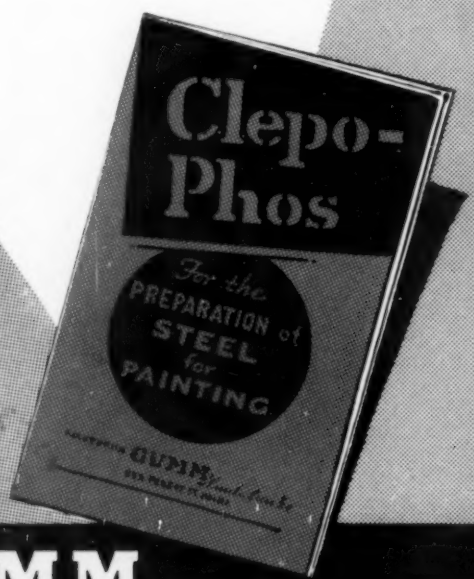
For more information contact your Clepo Service Engineer or write for the Clepo-Phos booklet.

For Tank Dipping



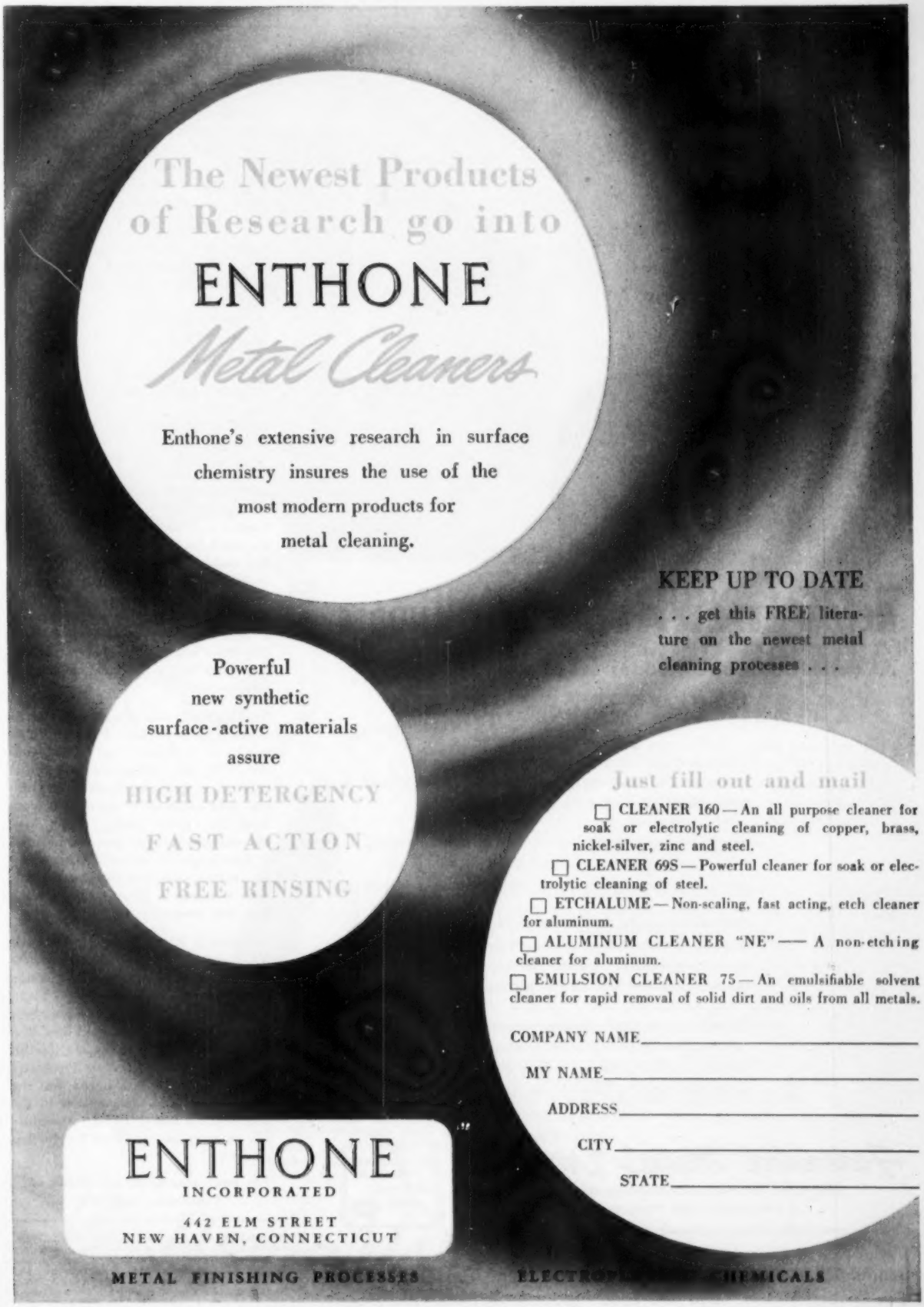
For Spray Washing Machine Treatment





FREDERICK **GUMM**
Chemical Company Inc.
538 FOREST STREET, KEARNY, N. J.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1000.


The Newest Products of Research go into
ENTHONE
Metal Cleaners
Enthone's extensive research in surface chemistry insures the use of the most modern products for metal cleaning.
KEEP UP TO DATE
. . . get this FREE literature on the newest metal cleaning processes . . .
Powerful new synthetic surface-active materials assure
HIGH DETERGENCY
FAST ACTION
FREE RINSING
Just fill out and mail
☐ CLEANER 160 — An all purpose cleaner for soak or electrolytic cleaning of copper, brass, nickel-silver, zinc and steel.
☐ CLEANER 69S — Powerful cleaner for soak or electrolytic cleaning of steel.
☐ ETCHALUME — Non-scaling, fast acting, etch cleaner for aluminum.
☐ ALUMINUM CLEANER "NE" — A non-etching cleaner for aluminum.
☐ EMULSION CLEANER 75 — An emulsifiable solvent cleaner for rapid removal of solid dirt and oils from all metals.
COMPANY NAME
MY NAME
ADDRESS
CITY
STATE
ENTHONE
INCORPORATED
442 ELM STREET
NEW HAVEN, CONNECTICUT
METAL FINISHING PROCESSES
CHEMICALS

NEW FEDERATED ZINC ANODES

. . . Better Than Ball Anodes

. . . No Flash . . . No Gate . . . No Voids

Make your plating job easier by using Federated Zinc Anodes, the smooth zinc anodes that won't catch or stick when you drop them into the container.

These anodes are round on top, flat on the bottom . . . scientifically designed and cast in an open mold to give you a smooth-finish anode without voids or inclusions.

The material used for Federated Zinc Anodes . . . special high-grade zinc and no scrap . . . and Federated's known superiority in production combine to make these anodes the best on the market.

To order or to obtain further information on Federated Zinc Anodes or on any other anodes for the plating industry, call or write any one of Federated's 24 sales offices across the country. There is one near you.

Federated Metals Division

AMERICAN SMELTING AND REFINING COMPANY

120 BROADWAY, NEW YORK 5, N. Y.

In Canada: Federated Metals Canada, Ltd., Toronto and Montreal

Aluminum and Magnesium, Babbitts, Brass and Bronzes, Anodes, Die Casting Metals, Lead and Lead Products, Solders, Type Metals

In This Issue

Black Chromium-Base Electroplating by Martin F. Quaely is a paper that describes the deposition of black coatings from a bath that contains chromic acid and vanadium salts. Black deposits are obtained also from a chromium bath containing nickel salts.

Crack Free Chromium From Baths of the Self-Regulating High Speed Type by R. Dow and J. E. Stareck. A process for producing crack-free chromium electrodeposits is described. The plating characteristics of the process and the results of outdoor exposure and salt-spray corrosion tests on steel plated by the process, with and without undercoatings, are reported. Other physical properties are reviewed and illustrated.

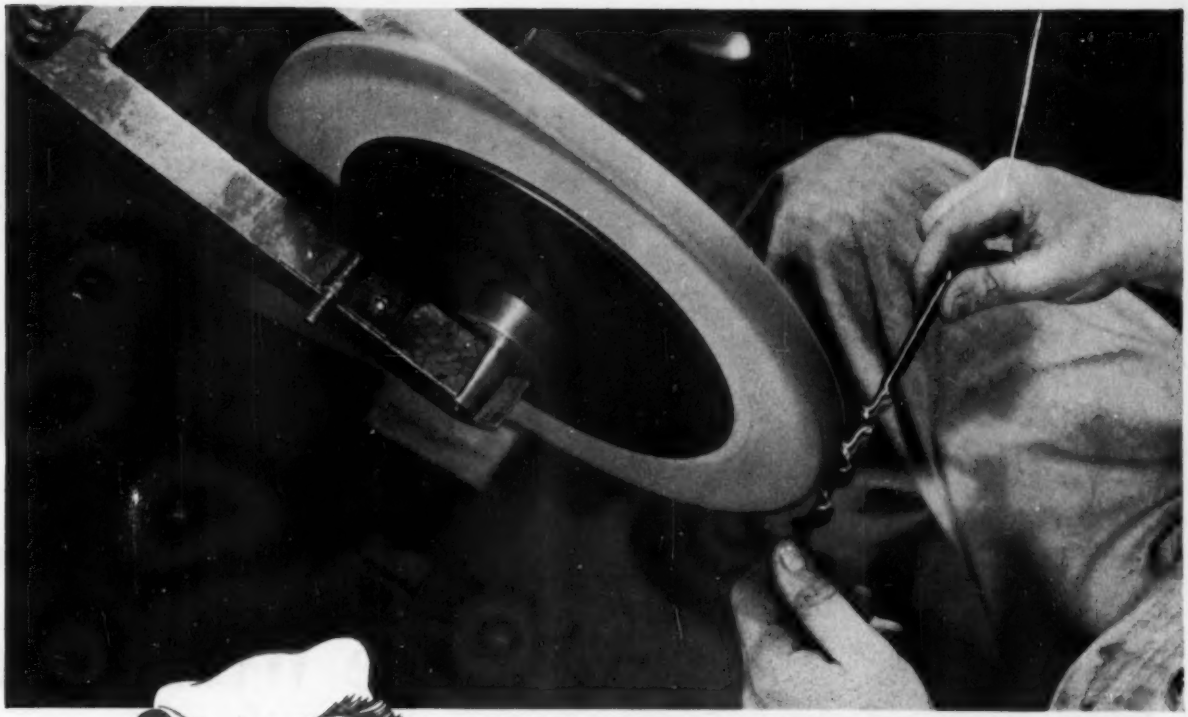
Cost Determination in the Industrial Chromium Plating Job Shop by William F. Walton and Pierre B. Lonsbury is a practical paper that presents a system for determining prices which has enabled the authors' shop to show consistent profits for fifteen years and to maintain a favorable competitive position during that time. Described is a tank-hour rate system as a basic charge to which extra charges for special racks and conforming anodes are added.

Stability of Ion Exchange Resins Toward Chromic Acid Plating Solutions by C. F. Paulson and G. H. Saunders. A new cation exchange resin which is resistant to 40 per cent chromic acid solutions is reported in contrast to earlier resins which were unstable above 10 per cent chromic acid. A description of an ion exchange unit for service with concentrated chromic acid solutions is given and operating data are presented.

Porosity of Electrodeposited Metals—XI. Analysis of Corrosion Products as a Method of Measuring the Change of Porosity in Corrosion by N. Thon, L. Yang, S. Yang is a paper from Project 6 which describes the application of a corrosion-product analytical method in the problem of electrodeposit porosity determination. It is believed that the method is a valuable addition to the field and it is hoped that the procedure will be adopted by others for further research.

For page numbers, see Table of Contents, page 979

Published monthly at 5800 N. Marvine St., Philadelphia 41, Pa. Entered as second class matter July 1, 1946, at the Post Office at Philadelphia, Pa., under Act of August 24, 1916. Subscriptions: Domestic and Canada, $4.00 for 1 year, $7.00 for 2 years 50c per copy; Foreign, $8.00 per year, $1.00 per copy



"IF IT'S POLISHING, LET ME DO THE EXPERIMENTING" SAYS POLISHER PETE

You may hit it in one — then again you may make many tries for the most profitable polishing method, get only a mediocre result. Consider the many variables in this polishing game — here are some:

2 Types of electric-furnace abrasive grain —
19 Sizes of abrasive grain —
9 Types of belt —

Over 15 types of contact wheels and that's only part of it — right there, are over thousands of possible combinations. Why waste good production time on hit-or-miss research when Polisher Pete has already gone over the ground and has your answer ready for you?

Polisher Pete symbolizes the BEHR-MANNING® Engineering Application Department, and the staff of BEHR-MANNING Abrasive Engineers, with this polishing data right at their finger tips, is all set to cooperate. Even if you *know* you are getting best results, why not confirm it. Call in your local BEHR-MANNING Field Engineer and make a double-check.

For some pretty solid facts on polishing, write for the booklet, "How Polisher Pete Put Economy in Polishing." Behr-Manning Corp., Troy, N. Y., Dept. PL-9.

For Export: Norton Behr-Manning Overseas Inc., New Rochelle, N. Y., U. S. A.
In Canada: Behr-Manning (Canada) Ltd., Brantford.

BEHR-MANNING®
CORPORATION
division of NORTON Company

▲ COATED ABRASIVES
▲ SHARPENING STONES
▲ PRESSURE-SENSITIVE TAPES

Let me show these Wyandotte can cut

In metal cleaning and related operations, in paint stripping, in preventing accidents due to slippery floors, and in maintenance cleaning, you can profit by using Wyandotte's specialized products.

In case after case all over the country, Wyandotte metal cleaning and related products are reducing cleaning and processing time, eliminating extra operations, producing better results, doing the job for less cost!

It's easy to find the reasons. Wyandotte is the world's largest manufacturer of specialized cleaning products for business and industry. Each Wyandotte product is backed by expert technical service in the field . . . by a dependable supply of raw materials from Wyandotte owned and operated resources . . . by more than half a century of diversified cleaning experience . . . by research facilities which are unequalled in the industry.

No matter what your metal-cleaning needs, Wyandotte's complete line includes a product tailored to your requirements. Send coupon for product data and your free copy of the booklet "Graphic Presentation of Wyandotte Products for Metal Working and Metal Finishing Industries."

Wyandotte has the largest field service organization in the industry. Call on your Wyandotte representative to work with you in your plant—to show you how the Wyandotte line of metal-cleaning products can help you solve finishing problems and save money.

Wyandotte
Reg. U.S. Pat. Off.
CHEMICALS

Helpful service representatives in 138 cities in the United States and Canada

Largest manufacturers of specialized cleaning products for business and industry

you how Products† your costs!

†Product	USE
A.E.	Easy to handle, dry-type pickling product.
ALTREX*	Nonetching aluminum cleaner — meets government specifications.
B.N.	Versatile nonferrous electrocleaner.
BURNEK 22	Low cost ferrous and nonferrous burnishing product.
C.S.R.	Smut removing electrocleaner.
EMLON*	Highly stable, versatile emulsion cleaner.
F.S.*	Fast acting anodic steel cleaner.
HEDRAL	Dry-wall paint booth coating.
INDUSTRIAL "D"	Versatile water-wash paint-spray booth product.
INDUSTRIAL No. 38	High detergency spray washer cleaner.
MERSOSTRIP	Fast acting alkaline paint stripper.
NORDALL*	Economical, rust inhibiting emulsion cleaner.
No. 90	Chrome resistant electrocleaner.
PRE-FOS*	High detergency phosphating product.
R-2	Neutral rust inhibitor.
444-C	Brush-on organic paint stripper.
P-1075	Immersion-type organic paint stripper.
W.L.G.*	High detergency soak cleaner.
ZORBALL	Safest, lowest cost, all purpose floor absorbent.

*REG. U.S. PAT. OFF.

Wyandotte Chemicals Corporation
Dept. 2134, Wyandotte, Michigan

Gentlemen: Please send me

☐ Free booklet "Graphic Presentation"
☐ Information on the following products—

_____ _____ _____ _____

Name _____

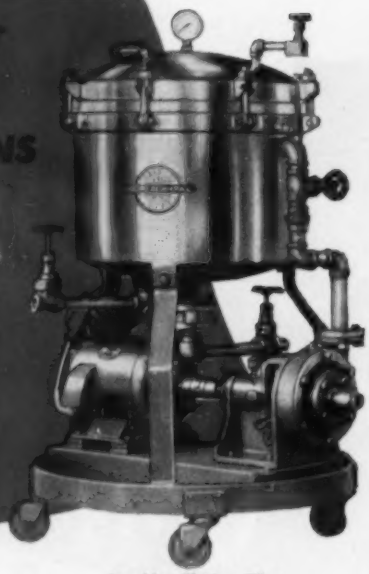
Firm _____

Address _____

City _____ Zone ____ State _____

FOR LOW COST FILTERING OF PLATING SOLUTIONS

SPARKLER HORIZONTAL PLATE FILTERS



Sparkler Plating Filter
Model 18-D-6 Alliron
600 G.P.H. Portable

HERE'S HOW

★ On a horizontal filter plate it is possible to apply a thin pre-coat with about one-third the filter aid, and in one-third the time required for pre-coating a non rigid media or a surface in a vertical position. This saves time and filter aid.

★ With the Sparkler horizontal plate you can apply this thin pre-coat evenly over the entire plate surface and start filtering immediately with less pressure and obtain maximum consistant clarity right from the start up to the end of the cycle.

★ A filter cake on a horizontal plate will not crack, slip or fall off even with varying pressure or a complete shut-down of the filter. No pre-coat renewal is ever required after an interruption in operation.

★ When it is necessary to clean the filter, the Sparkler filter tank can be emptied in a matter of minutes with a minimum of loss of valuable plating solution.

★ Any grade of filter paper from fine to coarse can be used in a Sparkler filter. This makes it ideal for carbon treatment of solutions. Carbon mixed with water in a stand-by tank is circulated through a clean set of filter paper on the plates until a carbon cake is formed. The solution requiring carbon treatment is then circulated through the carbon beds without contaminating the plating tank or a shutdown of plating operations.

★ At the end of the cycle with a Sparkler filter you can blow-down with air and produce a relatively dry cake that can be disposed of in a trash can rather than washing it down the drain with attendant sewer clogging problems.

★ You will find your Sparkler plating filter positive and dependable from a standpoint of uniform high quality filtering and economical in labor and material.

SPARKLER

Sparkler representatives in all principal cities are ready to give you personal service on your filtering problems, and show how you can make a material saving in operating cost.

MANUFACTURING COMPANY
Mundelein, Illinois

Sparkler International Ltd.
Prinsengracht 876, Amsterdam, Holland

Sparkler Western Hemisphere Corp.
Mundelein, Ill. U.S.A.

Industry News

New Home for Michigan Chrome. Michigan Chrome and Chemical Company have just moved into their new, modern office located at 8615 Grinnell Ave., Detroit 13, Mich

The office, built in conjunction with their new plant, brings management, sales, accounting, and purchasing under one roof. A total of 5,000 square feet of floor space is used for all the functions of the new office. All modern equipment is employed by a well-trained, experienced, and carefully picked staff. Ample "off the street" parking is available for visitors and both office and factory personnel.

New Norton Job Lapping Department. To further advance improvement of product performance in the metals industry through greater use of precisely lapped parts, Norton Company's Grinding Machine Division at Worcester, Mass., announces the establishment of a new department.

Called the Norton Job Lapping Department, the company has now broadened its lapping capacity to handle a multitude of job lapping projects.

A controlled atmosphere is provided to

Sustaining Members

The list of sustaining members continues to grow and the number of memberships climbs over the 350 mark with the addition of six newly reported organizations; four from Canada, and one each from Texas and California. These newest supporters of the A. E. S. Research program are:

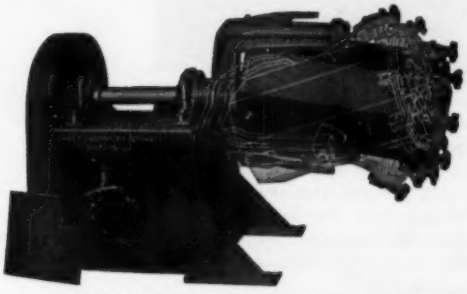
Associated Plating Company, Los Angeles, Calif.
Behr-Manning (Canada) Ltd., Brantford, Ontario
Dominion Foundries & Steel, Ltd., Hamilton, Ontario
Houdaille-Hershey of Canada, Ltd., Oshawa, Ontario
Lane Plating Works, Dallas, Texas
Sunbeam Corporation (Canada) Ltd., Toronto, Ontario

USE "RELIANCE" PRODUCTS FOR

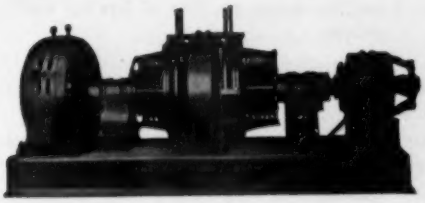
ECONOMY : EFFICIENCY : DEPENDABILITY

LET US SUPPLY YOUR NEEDS FOR YOUR PLATING OR POLISHING DEPARTMENT

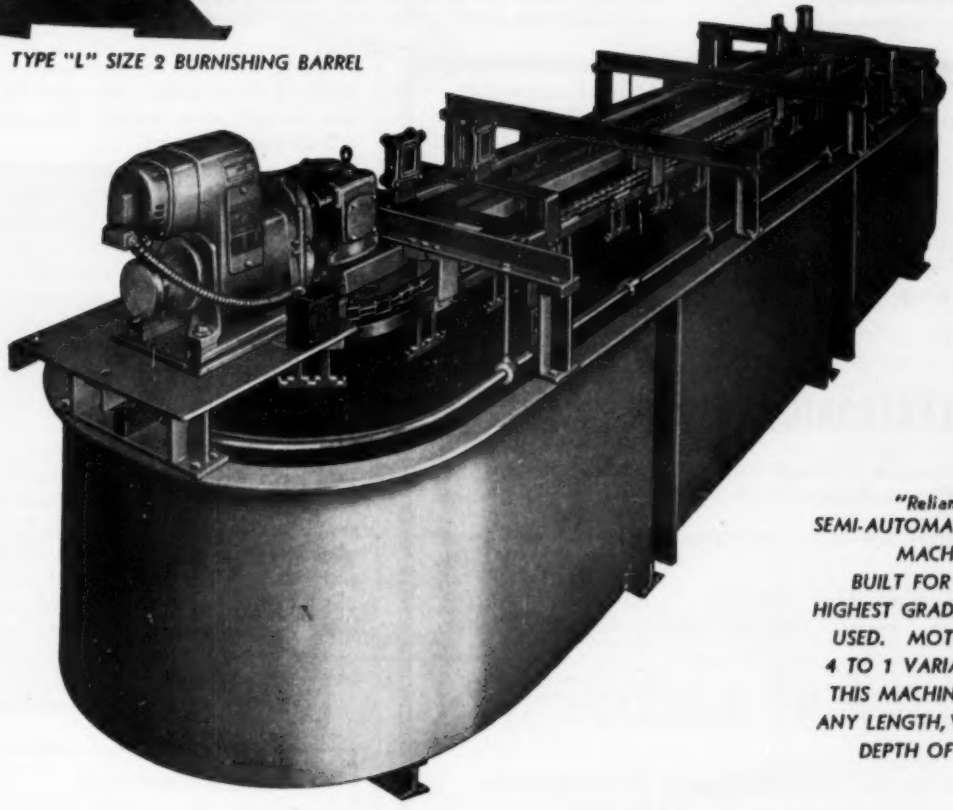
WRITE FOR FURTHER DETAILS



TYPE "L" SIZE 2 BURNISHING BARREL



3000 AMP. 6 VOLT GENERATOR SET



"Reliance" SEMI-AUTOMATIC PLATING MACHINE BUILT FOR SERVICE HIGHEST GRADE MATERIAL USED. MOTOR ½ HP 4 TO 1 VARIABLE SPEED. THIS MACHINE IS BUILT ANY LENGTH, WIDTH AND DEPTH OF TANK.

Chas. F. L'Hommedieu & Sons Co.

MANUFACTURERS of

Plating and Polishing Machinery

Complete Plating Plants Furnished

Chas. B. Little Co.
Newark, N. J.

W. R. Shields
Detroit, Mich.

O. M. Shoe
Philadelphia, Pa.

Gen. Office and Factory:
4521 Ogden Ave.

CHICAGO

Branches:
Cleveland
and
Los Angeles

assure production of the finest quality products. The machines are operated by highly skilled personnel whose work is checked by the most modern electrical and optical inspection equipment.

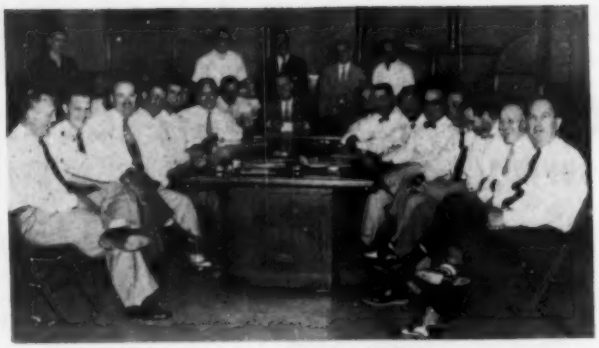
Direct supervision of this expanded activity is by lapping engineers who pioneered the process of mechanical lapping and developed the line of lapping machines.

Free Electroplating Course Contest. The Joseph B. Kushner Electroplating School of Stroudsburg, Pa., announces a contest for a scholarship in Electroplating Know How, a home study training course in modern electroplating. The scholarship, worth $125, pays the complete tuition for the course, which is given under license from the Department of Public Education of the Commonwealth of Pennsylvania. The contest is open to any person actively connected with the plating industry.

Contestants must submit in 250 words or less, a discussion on the subject: "What I Like and Dislike About the Electroplating Industry".

A board of three judges to be announced at a later date will select the winning entry. The entries will be judged solely on constructiveness and sincerity of thought. Fancy English and rhetoric will not count in the selection of the winning entry.

The contest will close December 1, 1953 and the winner will be announced some time in January, 1954. All contest entries must be submitted along with an official contest entry blank. For an official entry blank, and a complete set of rules and helpful hints on submitting entries, write to: Electroplating Correspondence Course Contest, 115 Broad St., Stroudsberg 1P, Pa.



Almco Sales Meeting. More than 20 men participated in a large general sales meeting held recently in Albert Lea, Minn. Standing in the background are Harold Mickelson, in charge of the laboratory; Lee Watkins, director of sales and research; R. C. Trow, Vice-President and General Manager; James Tschann, Sales Co-ordinator; and Chet Piotrawski, Sales Engineer. Seated are the Almco sales engineers. The meeting was presided over by D. J. Foley, Secretary and Legal Advisor

HERE'S WHY

it's easier to do your thickness testing with the

KOCOUR ELECTRONIC THICKNESS TESTER

1 Thickness testing is no longer a tedious, time consuming task. Tests require only about a minute to make.

2 Very simple to operate . . . no highly skilled technicians are required.

3 The instrument is virtually automatic . . . readings are direct . . . the human element does not affect the accuracy which ranges from 90–95%.

4 The minimum thickness which can accurately be determined is 5 millionths of an inch (5 ten-millionths of an inch for chromium.)

5 Requires no graphs, no charts, no standards or calculations.

6 Magnetic properties of either the base metal or the plating do not affect the test in any way.

7 Guaranteed satisfaction.

* Operation 105–125 Volts, 60 cycle A. C.

Write today for complete information

KOCOUR COMPANY

4801 S. St. Louis Ave.
Chicago 32, Illinois

• Pioneers & Specialists in Test Sets & Instruments for the electroplating industry since 1923.

Specify KOCOUR TEST SETS from your supplier.

SALES ENGINEER
For Chicago Area

Excellent opportunity for experienced Sales Engineer who has been calling on engineering and electroplating companies and chemical plants. Knowledge of pickling and plating operations and corrosion necessary. Desired by 25 year old Midwest manufacturer of corrosion-proof equipment. Give complete resume and requirements. All replies will be treated strictly confidential.
Reply to:

P-953-A, PLATING
445 Broad St., Newark 2, N. J.

HERE'S WHY the Sensational Sel-Rex Bright Gold Process IMPROVES QUALITY ...With LESS GOLD

Just note on the chart below the comparative facts between conventional and SEL-REX golds as confirmed by an independent testing laboratory. SEL-REX gold produces mirror-like deposits regardless of thickness . . . without scratch brushing or buffing. Its exceptional hardness resists abrasion, wear and galling . . . affords far greater corrosion protection. Less gold is required to secure minimum specified thicknesses, yet has unusually good "throwing power" to plate interior surfaces and deep recesses without the need for auxiliary anodes.

- Extra Hard
- Brighter and Smoother
- Excellent Metal Distribution
- More Economical
- Room Temperature Operation

TEST	CONVENTIONAL GOLD	BRIGHT GOLD	RESULT
SMOOTHNESS Profilometer Test Gold Thickness .0005"	Before plating: 1.5 micro-inches R.M.S. After plating: 8.0 micro-inches R.M.S.	Before plating: 1.5 micro-inches R.M.S. After plating: 1.5 micro-inches R.M.S.	BRIGHT GOLD gives exact duplication of the surface plated—does not deform or alter contour. Requires no scratch brushing or buffing.
HARDNESS	Tukon Hardness Converted to Vickers Scale — 65 Knoop Hardness — 47.54	Tukon Hardness Converted to Vickers Scale — 115 Knoop Hardness — 85.51	Less BRIGHT GOLD is required to give greater protection against wear, galling and corrosion.
METAL DISTRIBUTION Thickness Measurement Gold Thickness .001"	Distribution ratio 4 to 1 Edge to Dead Center	Distribution ratio 1.5 to 1 Edge to Dead Center	Less BRIGHT GOLD is required to secure minimum specified thickness. "Throws" well into deep recesses and "blind" holes.
ABRASION TEST Experimental Taber Abraser-CS 10 Wheels 500 gram load	Initial breakthrough 2,400 revolutions Exposure after 9,000 revolutions — more than 40%	Initial breakthrough 3,300 revolutions Exposure after 9,000 revolutions — less than 10%	BRIGHT GOLD gives 40% more protection against wear and abrasion.
SIMPLICITY OF OPERATION	High temperature 140°F.—160°F.	Room temperature 55° F.—75° F.	BRIGHT GOLD bath does not deteriorate, and is easier to control and maintain.

No special equipment is required for plating with SEL-REX BRIGHT GOLD. Conventional racking may be used. The SEL-REX BRIGHT GOLD BATH operates at room temperature and is simple to maintain. Solution is stable. Packaged in 1, 5, and 10 ounce bottles. Send for a trial order of 1-ounce today.

Manufacturers of SEL-REX Silver Sol-U-Salt, Gold and Rhodium

SEL-REX PRECIOUS METALS, INC.

Dept. PL-9 • 229 Main Street, Belleville 9, N. J.

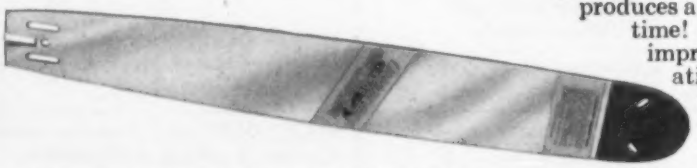
HOW WOULD YOU SOLVE IT?

PRODUCTION PROBLEM: To produce a higher finish—with greater customer appeal—on chain saw bars at the Oregon Saw Chain Manufacturing Company. (The maker of the famous ARMOR-TIP Saw Bar desired an appealing, lustrous finish on this alloy-tipped bar).

1 A 3M REPRESENTATIVE analyzed the finishing operation and demonstrated how the 3M Backstand Method, using Three-M-ite Cloth Belts, would produce a better finish on the alloy tip than was achieved with a grinding wheel alone.

2 3M ALSO RECOMMENDED the right 3M Abrasive Belt on their Curtis Straight-O-Matic Grinder for final finish on saw bar surface. Previously, manufacturer had used a surface grinder for this operation.

3 NOW, this Portland, Oregon manufacturer produces a finer, more attractive finish in less time! Perhaps a 3M Representative can improve *your* company's finishing operations. His training and experience in industrial application of coated abrasives are available without cost or obligation.



WANT MORE INFORMATION?

Minnesota Mining & Mfg. Co.
Dept. PL 93, St. Paul 6, Minn.

☐ Return this coupon today for more facts on 3M Abrasive applications.
☐ Have 3M Representative call.

Name.....

Company.....

Address.....

City.....Zone...State.....

3M ABRASIVES

Made in U. S. A. by
MINNESOTA MINING & MFG. CO.
General Offices: St. Paul 6, Minn. In Canada: London, Ont., Can., Export: 122 E. 42nd St., New York City.

Makers of "SCOTCH"® Pressure-Sensitive Tapes • "SCOTCH"® Sound Recording Tape • "UNDERSEAL"® Rubberized Coating "3M"® Adhesives • "SCOTCHLITE"® Reflective Sheeting • "SAFETY-WALK"® Non-Slip Surfacing.

Industry News

Ransohoff in New Plant. N. Ransohoff, Inc., America's pioneer producer of equipment for surface treatment of metals, recently undertook one of the most important steps in the 36-year history of the company and its development when it moved from its original location in Elmwood, a Cincinnati suburb, to a much larger, completely modern plant in Hamilton, Ohio.

The move provides Ransohoff many advantages in greatly enlarged production facilities, and the consolidation of all administrative, engineering, experimental, and sales departments in one location.

Even though the Ransohoff post office address has been changed from Cincinnati to Hamilton, the change of location involved a move of but a few miles and has had no effect on the retention of key personnel, or experienced engineers and mechanics.

New Vacuum Rhodium Coating Service. Serfass Corporation, 524 W. Broad St., Bethlehem, Pa., has announced that it is equipped to apply coatings of rhodium to non-conducting and conductive materials by using the vacuum technique. Rhodium is being applied on a commercial basis upon glass and other non-conductive substances to meet specifications of transmittancy and hardness. Coating thicknesses can be applied to give controlled reflectivity or transmittancy within 5 per cent.

Serfass Corporation is equipped to apply rhodium as well as other metals that can be vacuum deposited, such as aluminum, gold and silver. The work is performed on a job basis.

Rhodium coatings when deposited upon glass and subjected to baking become extremely hard, and the coating, therefore, is ideal for making thin hard surfaces to resist wear or friction. In addition to the vacuum coating facilities, Serfass Corporation is equipped to measure reflectivity, porosity and transmittance of coatings.

The coating service is available to technical laboratories, industrial organizations and the general public. General offices, laboratory, and production facilities of the company are located at 442 Elm St., New Haven, Conn

Whittaker Now Grinds and Processes Italian Pumice. Having recently sold its pumice operations at Grants, New Mexico, Whittaker, Clark & Daniels, Inc., 260 W. Broadway, New York 13, N. Y., now imports specially selected crude pumice from Italy for grinding and processing at its new plant in South Kearny, N. J.

A large inventory of the crude ore is maintained at South Kearny, to insure uninterrupted production and shipment.

The ore in the processing procedure passes from the storage bins through a crushing operation and then over a magnetic separator to remove any free iron or other foreign matter which might have

PLATER WANTED

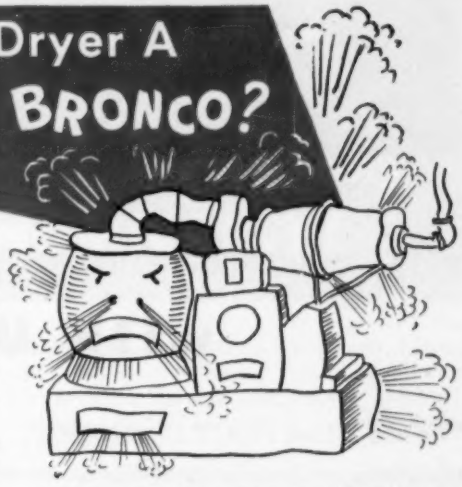
If you are looking for a future, age no limit, small shop, at present 3 polishers employed, Silver, Gold and Chromium.

Ace Electro Plating Wks.
2655 6th Ave. So.
St. Petersburg, Fla.
Joseph S. Linn—owner

FOREMAN WANTED

Foreman, Hard Chrome. Exceptionally good opportunity in Philadelphia area. Permanent job. State qualifications, including schooling and work history, in first letter; also salary desired.
Reply to:
P-953-B, PLATING
445 Broad St., Newark 2, N. J.

Is Your Dryer A BUCKING BRONCO?



In order for a centrifugal dryer to stay put it should be heavy. That's why the modern Nobles Dryer is about twice the weight of most dryers. Extra weight is one of the reasons for its stability, its freedom from vibration, its smooth operation, and long trouble-free life.

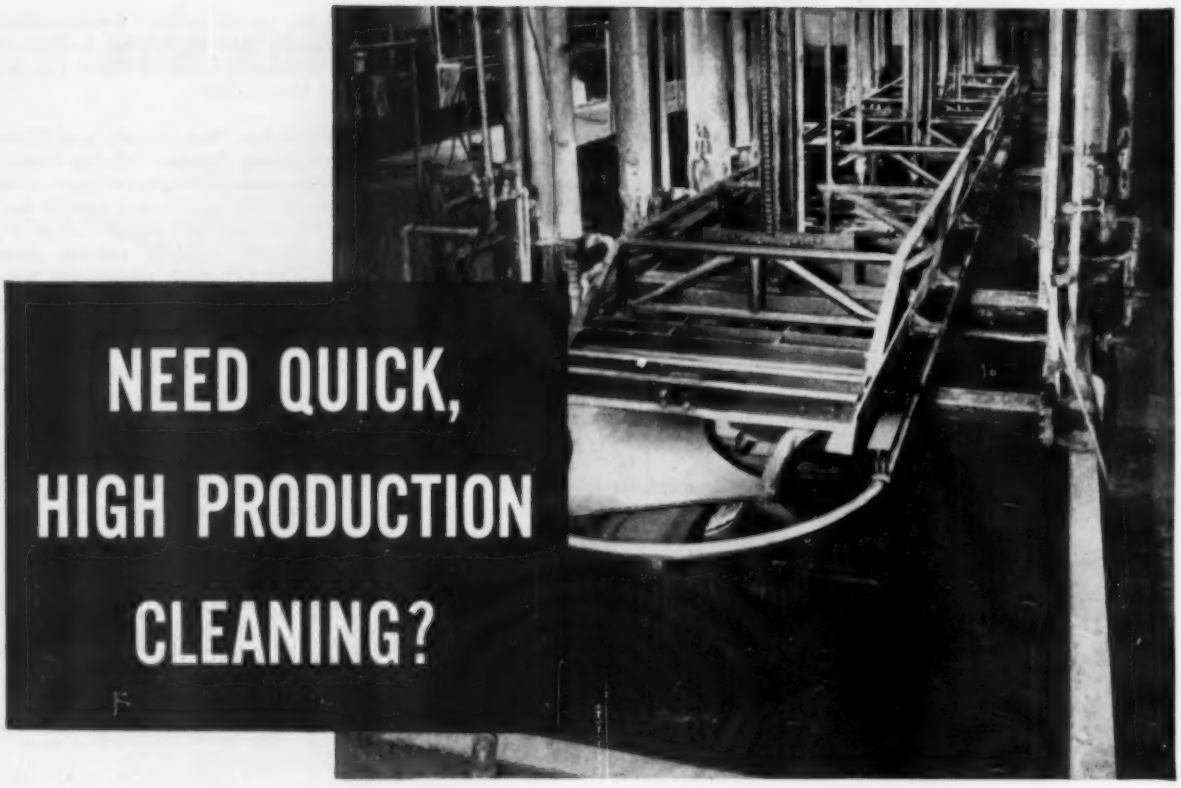
It's all new in design and principle. A powerful suction fan *draws* the air completely through this modern Nobles Dryer and exhausts it at the bottom! Electric or steam heaters are mounted in the cover of this machine of advanced design for a saving of space and elimination of heat loss.

Air moving equipment isn't an extra. The powerful suction fan is an integral design feature of each machine. A brake pedal extending around the entire work area controls an internal, expanding hydraulic brake for quick, smooth stops.

Why not take the first step now toward modern quick drying and lowest costs?

NOBLES ENGINEERING & MANUFACTURING CO.
ST. PAUL 4, MINNESOTA

Write Today for the FREE NOBLES DRYER BROCHURE



NEED QUICK, HIGH PRODUCTION CLEANING?

METAL MOULDINGS CORPORATION OF DETROIT DOES IT AUTOMATICALLY

with UDYLITE EQUIPMENT!

"We had to have a FAST . . . yet SURE . . . method of cleaning our automotive stampings before plating. And these stampings are *really* intricate shapes. That's why we chose AUTOMATIC cleaning using a Udylite Full Automatic."

Yes, that's what the people of Metal Mouldings Corporation, Detroit, Michigan, told Udylite. They must combine a large volume of cleaning with no rejects. They found that Udylite equipment assured them of high production...while it saved time and manpower.

If you have cleaning problems . . . let the Udylite Corporation provide the answer. Your Udylite Technical Man will show you a faster, more economical, AUTOMATIC way to clean metal parts. Call him today or write direct for all the facts.

THE UDYLITE CORPORATION, DETROIT 11, MICHIGAN. *West of Rockies, L. H. Butcher Co., Los Angeles 23, California.*

PIONEER OF A BETTER WAY IN PLATING

THE Udylite CORPORATION
DETROIT 11, MICHIGAN

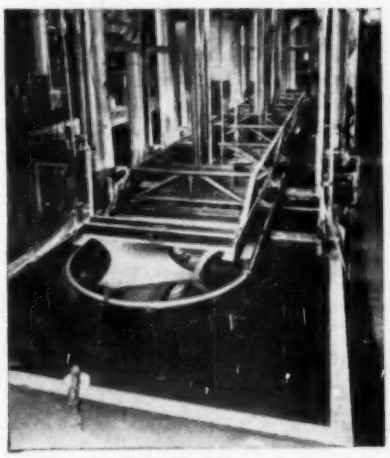
Udylite

METEX
CHROMEFOME
ZINCTEX
DYCLENE "E"
ROCHELTEX
ALUMETEX
ANODEX
TROXIDE
BLACKMAX
SOLVMAX "X"
CHROMETEX
ALUM-I-NIEL

CLEANING SUPPLIES WORK *FASTER, BETTER, MORE ECONOMICALLY!*

Whether used with Full Automatic Cleaning Equipment, still tanks or barrels, Udylite-MacDermid cleaners and compounds are faster . . . better . . . more economical! There's a special cleaner for every metal finishing purpose and prompt delivery is assured. Check these three general divisions . . . you'll see what a complete answer Udylite can give to *your* metal cleaning problems:

Typical Full Automatic Cleaning Installation at Metal Mouldings Corp., Detroit, Michigan



Steel Base—All cleaners in this general group are either electrolytic, soak, spray or general purpose types of compounds. They are especially adapted for cleaning steel base materials, either with direct or reverse current.

Brass and Die Castings—Cleaners in this group are composed of electrolytic, soak, spray and burnishing types of compounds. They are ideal for brass, zinc, and aluminum diecastings, since they will not discolor base metals.

Specialties—Compounds in this group fit a wide range of special metal cleaning problems. Write for full information on metal cleaners.

The Udylite Corporation carries a complete line of MacDermid cleaning compounds. For the answer to your needs, call your Udylite Technical Man. He can help select equipment and cleaners which give you an economical, FAST answer. Or, if you prefer, write direct. The Udylite Corporation, Detroit 11, Michigan. *West of Rockies, L. H. Butcher Company, Los Angeles, California.*

PIONEER OF A BETTER WAY IN PLATING

THE *Udylite* CORPORATION
DETROIT 11, MICHIGAN

LOW COST
IRIDITE®
FINISHES

for zinc, cadmium, aluminum and cuprous metals

provide corrosion resistance
paint base
choice of appearance

And they are easy to apply! Just a simple chemical dip for only a few seconds produces the coating.

LOW MATERIAL AND SHIPPING COSTS

combine to make Iridite the most economical chromate finish you can buy. Many Iridite chemicals are packed in powder form, thus can be shipped to you in steel pails at freight savings of up to 75%! Pails take less storage space, are easier to handle, eliminate carboys, need not be returned.

WHY NOT TEST IRIDITE ON YOUR PRODUCTS? Write for literature and send samples for free test processing. See "Plating Supplies" in your classified telephone directory or write direct.

ALLIED RESEARCH PRODUCTS
INCORPORATED
4004-06 E. MONUMENT STREET • BALTIMORE 5, MD.

Industry News

gotten into the crude pumice in handling and shipping. It then goes through a drier to remove excess moisture; for only dry, hot pumice bolts freely and permits clean grading.

Special Course in Electroplating. Joe Andrus, president of Chicago Branch and chief metallurgist for Croname, Inc., will once again be the instructor for a special course in the Basic Principles of Electroplating to be conducted at the Illinois Institute of Technology, 33rd and State Streets, Chicago, Ill. Registration for these classes will be held on September 14 and 15, with classes beginning Monday, September 21 and every Monday thereafter from 8 until 10 P. M. The registration fee is $36.00 per semester and the course includes two semesters of work.

Classes are conducted on a lecture and laboratory basis with students obtaining both academic and practical knowledge of electroplating principles through actual experience in operation of accepted plating techniques. Registration is limited and those interested should plan for early registration in order to insure participation in this valuable course.

New Home for New England Buff. The New England Buff Company, formerly of Boston, Mass., is now at its new main office and plant in Suncook, N. H. All correspondence, orders and inquiries, etc., should be addressed to the new Suncook, N. H., address. The company's new telephone number is Suncook 422.

The company, having been located in Boston for over 63 years, the decision to move was given every consideration as to the advantages to be gained. The expansion of business has made this change necessary. The company now occupies its own building, with more adequate receiving and shipping facilities.

Change of Address Notice. The O'Donohue Sales Company, Milwaukee distributor of industrial finishing supplies and equipment, now occupy new headquarters acquired through the purchase of the building and land at 3812–18 N. Hubbard St. The new location houses

WANTED

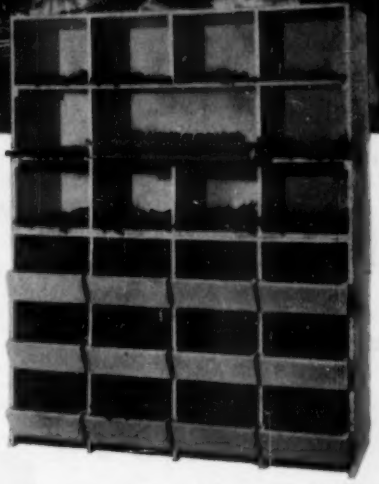
Leader Man, Hard Chrome. Rotating shift. Excellent opportunity in Philadelphia area. Permanent job. State qualifications, including schooling and work history, in first letter; also rate of pay. *Reply to:*

P-953-C, PLATING
445 Broad St., Newark 2, N. J.

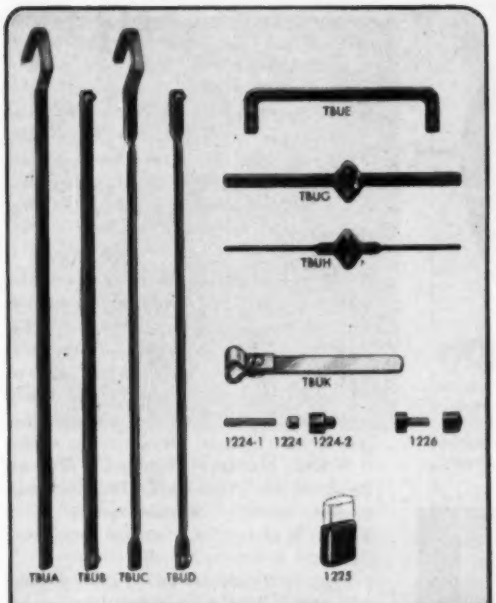
How to Convert Waste into PROFIT with Thinker Boy Plating Racks

Conventional plating racks by the thousands—stored overhead in the hope of possible re-use.

Discarded racks awaiting favorable scrap market after all hope of re-use is gone.



Thinker Boy Parts from thousands of racks can be stored in small space—ready for instant re-use in new racks of different types. That's how Thinker Boy Plating Racks convert waste into Profit.



Thinker Boy—preformed rack sections—precoated with BELKE Universal Plastic and equipped with BELKE Vac-Seal Fittings. Assemble with a leakproof seal for quick, economical manufacture of the racks you need *when* you need them!

Part No.	Lengths (overall)
TBUA	24, 30, 36"
TBUB	6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 30, 36"
TBUC	24, 30, 36"
TBUD	10, 12, 14, 16, 18, 20, 22, 24, 30, 36"
TBUE	6, 8, 10, 12, 14, 16, 18, 20, 22, 24"
TBUG	10, 12, 14, 16, 18, 20"
TBUH	10, 12, 14, 16, 18, 20"
TBUK	Attachable Handle—Clamps on cathode hook
1224	Tapered Stainless Steel Nut
1224-1	Stainless Steel Stud
1224-2	Plastic Cover Cap
1226	Plastic Plug for unused holes
1225	Boot—Used to cover cut end of sectional member

Send for bulletin illustrating the great variety of BELKE Removable Tips for Thinker Boy Racks.

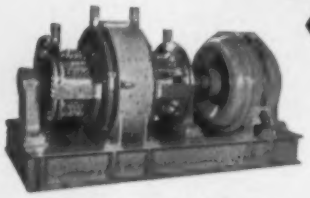
When Thinker Boy Racks of one type or style are no longer needed they do not become worthless as do other racks. The parts can be used in racks of different styles or stored in small space for future needs.

These great economies are possible because Thinker Boy Racks are made of standard, precoated parts assembled with screws. Disassembly or conversion to other styles is fast, easy and extremely practical.

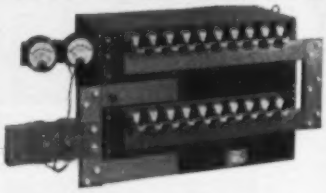
A new illustrated bulletin, just off the press, shows how to make racks designed with Thinker Boy Sections. Send for your copy today—it's the key to revolutionary reduction in plating rack costs.

Belke MANUFACTURING CO.
947 N. Cicero Ave.
Chicago 51, Ill.
EVERYTHING FOR PLATING PLANTS

COLUMBIA



MOTOR GENERATORS
for Electroplating, Anodizing,
Electrocleaning, Electropolishing



TANK RHEOSTATS

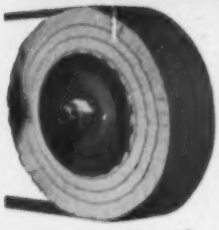
- REVERSING SWITCHES
- TONG TEST AMMETERS

Protected Territories Available to Qualified Sales Engineers

COLUMBIA ELECTRIC MFG. CO.
4533 HAMILTON AVE. • CLEVELAND 14, OHIO

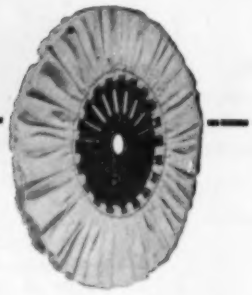
FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1015.

A FEW OF THE MANY
FORMAX
PRODUCTS



STYLE C-20
CONTACT WHEELS
and F-26 Belt Lubricant

A C-20 flexible Contact Wheel will form itself to the shape of the work and permit the abrasive felt to polish contoured surfaces and F-26 Abrasive Belt Lubricant will increase belt life by preventing loading and glazing. Produces finer, smoother and brighter surfaces through lubrication.



ZIPPO BUFFS

These famous long-wearing buffs run cool under all buffing conditions. Constructed of high count bias-cut cloth or sisal mounted on safe steel centers. Available in a wide range of densities and center diameters.

A complete line of buffing compounds in bar form as well as in liquid form for brush or spray application. Also Flex-A-Glu polishing wheel cements.

Our Laboratory and Sales Engineering staff would welcome the opportunity to be of help in solving your finishing problems.

Send for descriptive literature

FORMAX MFG. CORP.
DETROIT 7, MICHIGAN
"THE FOUR McALEERS"

MANUFACTURED IN CANADA BY JOHN GALLOWAY LTD., KITCHENER, ONT.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1016.

Industry News

general offices, laboratory and the No. 1 Milwaukee warehouse of the firm. Plans are to enlarge the new facilities to handle the entire Milwaukee requirements from the new location.

First International Conference on Industrial Cleaning. How do the airlines of Australia clean engines that come in for reconditioning? How is this same job done in England, France, Switzerland, Norway, and in the United States of America? What is the procedure in these various countries for cleaning paint stripping? What about cleaning equipment in all these industries? What developments have there been in each country on washing machines, degreasers, steam cleaners?

W. M. Campbell, President of Magnus Chemical Co., Inc., of Garwood, N. J., has just returned from France, where the Magnus organization held the first International Conference on Industrial Cleaning that has ever been held. Headquarters was the Hotel Bristol, Paris, France.

The information which came out of this conference will be correlated and sent out to Magnus manufacturers and representatives all over the world so that customers, through its service representatives, will promptly get the benefit of anything new on industrial cleaning.

Fanner Acquires Munray Products, Inc. Fanner Manufacturing Company, Cleveland, Ohio, announces its expansion into the plastics industry with the purchase of Munray Products, Inc., also of Cleveland and manufacturers of many types of plastics including plastic pipe, plastic tank linings, plastic coatings, etc.

William Munkacsy, founder of Munray Products, Inc., remains as President and General Manager of that company and will be in charge of Fanner's plastic activities.

Munray Products, Inc., will continue in business in their present location at 12400 Crossburn Ave., Cleveland 11, Ohio.

ORSANCO Meeting. Representatives of more than a hundred major industrial plants met with the Ohio River Valley Water Sanitation Commission at its quarterly meeting in Charleston, W. Va., to

CHEMICAL ENGINEER

Experienced and well-qualified in all phases of electroplating industry, such as solution control, equipment engineering, and personnel supervision. Desires position as plating production supervisor. *Reply to:*

P-953-D, PLATING
445 Broad St., Newark 2, N. J.

join in discussions on progress in stream pollution control. The Commission represents eight states in the region which are united by a compact to enforce measures for stream clean-up in a 155,000 square mile area of the Ohio River basin.

The industry representatives are members of committees who are working jointly with the Commission to promote pollution abatement within their own ranks. They include the metal-finishing, steel, chemical-salts, bituminous coal, distillery, oil refining and organic chemical industries. Among other things, the committees are developing manuals on "good housekeeping" and treatment methods to curb the discharge of pollutional substances.

Aluminum Coating Research Project. In an effort to find a substitute for scarce tin, Arthur C. Doumas, of Fredericksburg, Va., will conduct a graduate research project at Virginia Polytechnic Institute directed toward the development of an electrochemical method of giving steel a protective coating of aluminum, which is plentiful and relatively cheap.

Doumas is a candidate for the doctorate degree in chemical engineering and will receive $2,000 a year for his work, plus $1,000 a year for equipment and supplies. The project is expected to cover about two years.

Aluminum for Tin. If Arthur G. Doumas, Virginia Tech chemical engineering student, is successful in his research project, American housewives may be getting their beans, corn, and tomatoes in aluminum-coated cans instead of the tin-coated ones

Plastic Welding Training Course. American Agile Corp. announces the opening of their Welding Training School.

Welding courses at this school embrace lectures, design, theory, welding exercises, advance course and design of welding construction, reinforcements, structural design as influenced by temperature and chemical resistance.

These courses and facilities of the school are open to all those who wish to enter into the structural fabrication of the thermoplastic materials as well as those who wish and desire this knowledge for their self-sustaining purposes against the ravages of corrosion in their particular industry or plant.

Complete details and information, together with a booklet identifying the various lectures, exercises, and advance course in welding and flame spraying is available by writing to the American Agile Corporation, P. O. Box 168, Bedford, Ohio.

Industrial Wastes Committee Reports—The National Technical Task Committee On Industrial Wastes has issued a bulletin to its members and alternates which lists and briefly describes the training courses of their Environmental Health Center for the period July 1, 1953 to June 30, 1954. It is expected that announcements having a more detailed agenda of the individual training courses will be available to send some time in advance of the giving of each of the courses. Further information on these training programs can be obtained from the Specialized Training Section of the Environmental Health Center, Cincinnati, Ohio.

Also issued was a list of publications pertaining to water pollution control and sewage and industrial waste treatment.

PLATING SUPERVISOR

Plating Supervisor needed for Decorative Trim Manufacturer located in Ohio. Submit experience in detail. Replies held confidential. *Reply to:*

P-953-E, PLATING
445 Broad St., Newark 2, N. J.

YOU CAN START RIGHT
EVERY TIME
WITH PERMAG

Cleaning tanks, so important to improved production and faster operation, are the first units in producing uniform work for a uniform plate.

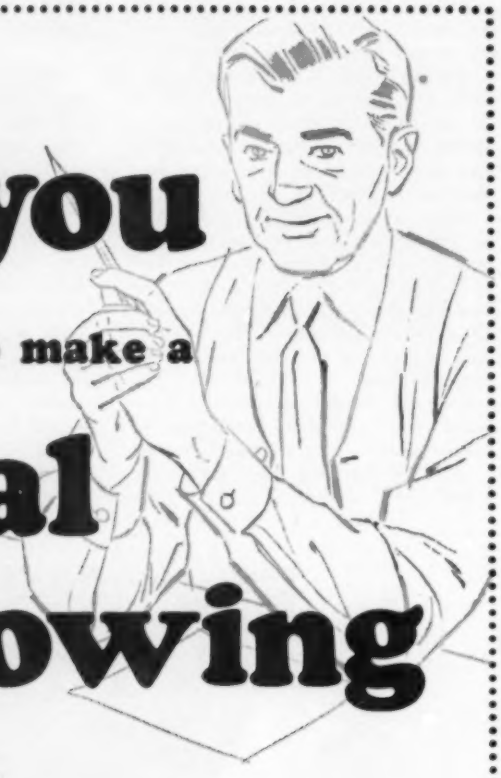
Offering every advantage you seek for this work, PERMAG will leave your job chemically clean without damage to the metal and at a minimum cost for maximum cleaning efficiency.

Our technical service staff will gladly consult with you on any cleaning problem you may have, without obligation.

Write for your FREE Electroplaters' Handy Pocket Size Manual on Cleaning Compounds.

If you have trouble with:
HAZY DEPOSITS,
BLISTERS,
PEELING,
CARRY-OVER,
CORROSION or
SMUT ON STEEL
—let us help you.

MAGNUSON
PRODUCTS CORPORATION
50 Court Street • Brooklyn 2, N. Y.
In Canada:
CANADIAN PERMAG PRODUCTS, LTD., MONTREAL



if you want to make a real showing in your plating

Ask MEAKER

With over fifty years' experience manufacturing automatic plating machines custom built for highest production at lowest unit cost for some of the largest plating departments, MEAKER has the know-how to help you make a real showing in your plating. For the complete story, ask The Meaker Company, 1639 So. 55th Ave., Chicago 50, Ill.

MEAKER PRODUCTS

Full Automatic and Semi-Automatic Electroplating Equipment
Strip Steel Plating Equipment • Wire Galvanizing Equipment
Pickling Machines • Process Conveyors
Motor Generators and Rectifiers

Special Machines for the Unusual Requirements

4483

Society News

The Electrochemical Society

A change of address has been announced by the Society. The offices are now at the new and larger premises at 216 W. 102nd St., New York 25, N. Y.

Institute of Metal Finishing

At the last council meeting of the Institute of Metal Finishing, it was decided that the Fourth International Conference on Electrodeposition and Metal Finishing will be held in London from Wednesday, April 21 to Saturday, April 24, 1954.

Fuller particulars of the program will be available in the near future.

Faraday Society

The Faraday Society celebrated its fiftieth anniversary at the Royal Institution on the afternoon of April 16. Later on the same evening there was a banquet held at the Dorchester Hotel, London, when the President, Professor H. S. Taylor, F.R.S., of Princeton University, welcomed guests.

Instrument Society of America

The I. S. A. has mailed out advance programs announcing the Eighth National Instrument Conference and Exhibit to be held in the Morrison and Sherman Hotels, Chicago, Ill., September 21–25, 1953.

This gathering, sponsored by the I.S.A., will include the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the Institute of Radio Engineers, and the Scientific Apparatus Makers Association. An attendance of over 15,000 is expected. Speakers will include more than 100 outstanding scientists and technical specialists from government, educational, and industrial organizations.

American Society for Metals

The 35th National Metal Exposition will be held in the Cleveland Public Auditorium during the period of October 19-23, 1953.

A. S. T. M.

At the 1953 annual meeting of the A. S. T. M. held June 28–July 3 at Atlantic City, seventy-two of the Society's technical committees reported, with the result that 63 new specifications and tests were approved. All of these new tentatives will be published later in the year in the 1953 Supplement to the Book of A. S. T. M. Standards. Included in the new tentatives was one submitted by the committee on Electrodeposited Metallic Coatings (B-8). This committee's specification, Recommended Practice for Preparation of Copper and Copper-base Alloys for Electroplating (B 281–53T), is of interest to members of the A. E. S.

Reduce Rejects Improve Quality

with DIAPHRAGM PLATING and ARco RUBBER LINED TANKS

● Providing for separate anode and cathode compartments, Diaphragm Plating Tanks, engineered by ARco . . . eliminate costly buffing due to roughness . . . prevent rejects due to thin spots . . . produce uniformly high plating quality.

Thoroughly experienced in all phases of electroplating, ARco engineers have an outstanding record of successful Diaphragm installations and conversions. They can help you achieve greater efficiency and higher quality production in your operations.

● Illustrated is a return-bend Diaphragm Plating Tank, fabricated and insulated by ARco.

SEND FOR THIS VALUABLE INFORMATION NOW . . . See the many ways in which you can reduce operational costs and improve electroplating production in quality and quantity.

ANYTHING CAN BE COVERED WITH RUBBER — BY ARco

AUTOMOTIVE RUBBER CO., INC.
12574 BEECH ROAD AT P.M.R.R. • DETROIT 28, MICHIGAN

ARCO RUBBER PROCESSORS
4033 HOMESTEAD ROAD • HOUSTON, TEXAS

MANUFACTURERS • DESIGNERS • ENGINEERS

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1019.

Personals

Walter Hardy has been promoted to the post of Director of Engineering for Foster D. Snell, Inc., New York City. Hardy joined the Snell organization as Director of Package Engineering in 1952. Hardy has a Bachelor's and Master's degree in Chemical Engineering from Cornell University. He has had an extensive background in petroleum, packaging and corrosion engineering, and is a member of numerous technical associations.

Albert E. Clement, Assistant Superintendent, has been named acting Superintendent of the Natrona plant and the Natrona subsidiaries of the Pennsylvania Salt Company as a replacement for Gail E. Barr who died recently.

Roy Rumbaugh has been appointed director of sales engineering by Klem Chemicals, Inc., Dearborn, Mich. Previously Rumbaugh represented Klem Chemicals,

Rumbaugh

Inc., as a manufacturer's agent for eight years. Before coming to Klem, he spent 17 years with Ford Motor Company. His new position will place him in the field where he will work with Klem service engineers in an advisory capacity.

H. Liggett Gray was elected to the office of second vice-president at a recent meeting of the board of directors of Oakite Products, Inc. At the same meeting, **Frank L. Oldroyd** was named vice-president, a post he will hold in addition to his present position as general sales manager of the company's industrial division. Also elected vice-presidents were **Eustace Lingle** and **Van Dorn C. Smith.** The former will continue to cooperate with the general sales manager in the direction and guidance of the firm's sales organization, and will be responsible for the functioning of its engineering, technical service and sales development departments, while the latter's duties will involve consultation work of a general technical and sales nature. Another change announced was the election of **George M. Seib,** assistant manager, to the office of secretary of the company. In addition to his new duties, he will continue to supervise personnel department operations and be responsible for general office administration policies and procedures.

William G. Gerstacker has been appointed Chief Engineer by the Heil Process Equipment Corp., Cleveland, Ohio. Gerstacker received his mechanical

Gerstacker

engineering degree from Case Institute of Technology and has had eighteen years' experience as estimator, product manager and chief engineer with other process equipment manufacturers principally in the chemical plant equipment field.

Other recent additions to the Heil staff include the appointment of **John M. Carpenter** as estimator in the lining and coating department and **Frank Babik** as estimator in the fabrication department. Carpenter received his Bachelor of Science

after the first call we generally have a steady customer for our

EXTRA HIGH QUALITY 99.7+% PURE

CHROMIC ACID

TECHNICAL GRADE—FLAKE

Only a few years ago we were new comers to the Chromic Acid business. Since then we've shipped quite a few million pounds . . . and made a lot of good friends, too.

We think you will like the quality of our products and the fair way we do business. Why not send us a modest order and judge for yourself? That's the simple way our present customers got started with BFC Chromic Acid.

BETTER FINISHES & COATINGS, INC.

268 Doremus Avenue, Newark 5, N. J.
122 East 7th St., Los Angeles 14, Calif.

BFC PAINTS · PLASTICS · CHEMICALS

POSITION AVAILABLE

Plating chemist for job shop plant. Fast growing concern, permanent position. Opportunities. *Reply to:*

P-953-F, PLATING
445 Broad St., Newark, N. J.

SYLVANIA

Lighting, Electronics, Radio, Television
Sylvania Electric Products Inc.

How Sylvania Electric cut cleaning costs 52.8% with Pennsalt Cleaners

A striking, although not unusual, example of the value of Pennsalt Cleaners comes from the Radio and Television Division of Sylvania Electric Products Inc.

In its Buffalo plant, this Division stamps out thousands of steel radio and TV chassis and other miscellaneous parts every day which are then zinc plated. After a survey of the plant, the local Pennsalt representative suggested that two Pennsalt Cleaners could definitely reduce cleaning costs in the plating operation.

After a test, the Pennsalt cleaners were adopted, and these were the results of the change:

1. Total consumption of cleaners was reduced in each four-week period from 2700 lbs. to 2140 lbs. including make-up schedules.

2. Previous cleaners cost $432.00 a month. The Pennsalt products run $204.78 a month—*a 52.8% saving.*

3. The Pennsalt Cleaners removed stamping oils and shop grime with equal or greater effectiveness than the previous cleaners and were in every other way completely satisfactory.

Here is a brief introduction to the two products that performed this notable cost-cutting feat: the first Pennsalt Cleaner is a concentrated, extra-heavy duty soak or immersion tank alkaline cleaner with exceptional emulsifying powers. The second Pennsalt Cleaner is an alkaline electrolytic cleaner specially compounded for removal of heavy smut deposits when used in reverse cleaning cycle.

The extensive Pennsalt Cleaner line includes products for virtually every type cleaning operation, and Pennsalt specialists have vast experience in properly applying them.

No matter how effective or economical you believe *your* present cleaners to be, there is a very good chance that a saving similar to Sylvania's can be made in your plant with Pennsalt Cleaners! Contact your Pennsalt representative today or write:

PENNSYLVANIA SALT MANUFACTURING COMPANY
Metal Processing Department
396 Widener Bldg., Philadelphia 7, Pa.

Pennsalt Chemicals

Personals

degree in Chemistry from the University of Arizona and has several years' experience in industry.

Babik has had approximately twenty years' experience in fabrication and layout work for all types of steel and alloy fabrications.

Fred W. Fraley has retired as a vice-president of Diamond Alkali Company. Fraley's 25-year career with Diamond began in 1928 as manager of Diamond's Southwest Sales Office in Houston, Texas. In 1943 he became vice-president-Sales, and has served as a director since 1947. He was also a director and former vice-president of the Chlorine Institute.

Always active in the chemical industry's relationship with the government, Fraley recently served with the National Production Authority under the "loan" plan whereby industry executives are recruited for temporary periods.

Willard L. Hults has been elected President of the Schnefel Bros. Corporation, makers of LaCross manicure instruments. He will fill the office vacated by the death of P. M. Schnefel.

Thirty-one years ago, Mr. Hults joined Schnefel as a Production Engineer at the age of 24 having previously been Manager of the Commonwealth Chemical Company of New York. In 1938 he was named Vice-President in charge of factory operations and Executive Vice-President in 1951.

Hults, a native of New Jersey, is a graduate from Rutgers University. He has been a member of the American Society for Metals for the past thirty years and served as Chairman of the New Jersey Chapter in 1946. He is now a member of the Advisory Committee. He is also a member of the American Electroplaters' Society.

Henry G. Zucker, Jr., has been appointed sales representative in the Chicago area by the Hanson-Van Winkle-Munning Company, Matawan, N. J.

Zucker, who is a graduate of Lafayette College, received extensive technical training at the H-VW-M laboratory following his graduation in 1949. He received additional training in sales at Matawan prior to coming to the Chicago office.

Zucker Smallman

The assignment of **Harold R. Smallman**, Assistant Vice-President, to handle all of its affairs on the west coast was also announced. His headquarters and office will be in Los Angeles.

Concurrently, the A. J. Lynch Company is appointed H-VW-M distributor in California, with headquarters in Los Angeles and additional warehouse facilities and sales personnel in San Francisco. Mr. Smallman will assist Lynch personnel.

Smallman moves to the coast from Chicago where he was the H-VW-M district manager for 23 of his 31 years of service with the company.

Howard E. Moses has assumed his new duties as chairman of the Ohio River Valley Water Sanitation Commission.

Formerly chief engineer and director of the Pennsylvania bureau of sanitary engineering, Dr. Moses has had supervision of public water supplies serving 8,000,000 people and has played a major role in the management of his state's stream pollution-control program. He was one of the participants in the negotiations that led to the formation of the 8-state compact commission for pollution abatement on interstate streams.

John C. Bovan and **George Baumgartner** have been named to positions in the Engineering and Research Departments, respectively, of the Atlas Mineral Products Company, Mertztown, Pa. Bovan holds a degree in Chemical Engineering from Lehigh University and has indus-

Only ONE QUALITY

the world's finest

Sel-Rex

PLATING RECTIFIERS

SEL-REX only makes *ONE QUALITY* — the world's finest! Yes, the world's finest engineering, the finest pre-tested components, the most stringent quality control . . . from top to bottom. SEL-REX adheres to high NEMA standards for the betterment of the plating industry. It does not pay to experiment with so called "budget-priced" equipment for it is a fact that a SEL-REX PLATING RECTIFIER *is the MOST ECONOMICAL* investment in the long run. Only SEL-REX Rectifiers are unconditionally guaranteed for 2 years.

NEMA

Pioneers and Builders of Time Tested COMPLETELY SEALED Plating Rectifiers

BART-MESSING CORPORATION

Dept. PL-9, 229 Main Street, Belleville 9, N. J.

BART-MESSING DISTRIBUTORS

Alert Supply Company
Los Angeles, California

Baker Bros.
So. Boston, Mass.

Thomas Closs
Towson, Maryland

Connecticut Metalcraft, Inc.
Division of Enthone, Inc.
New Haven, Conn.

General Supply Corporation
Cleveland, Ohio

Lea Products Company
Montreal, Quebec, Canada

MacDermid Sales & Equipment
Bristol, Conn.

J. C. Miller Company
Grand Rapids, Mich.

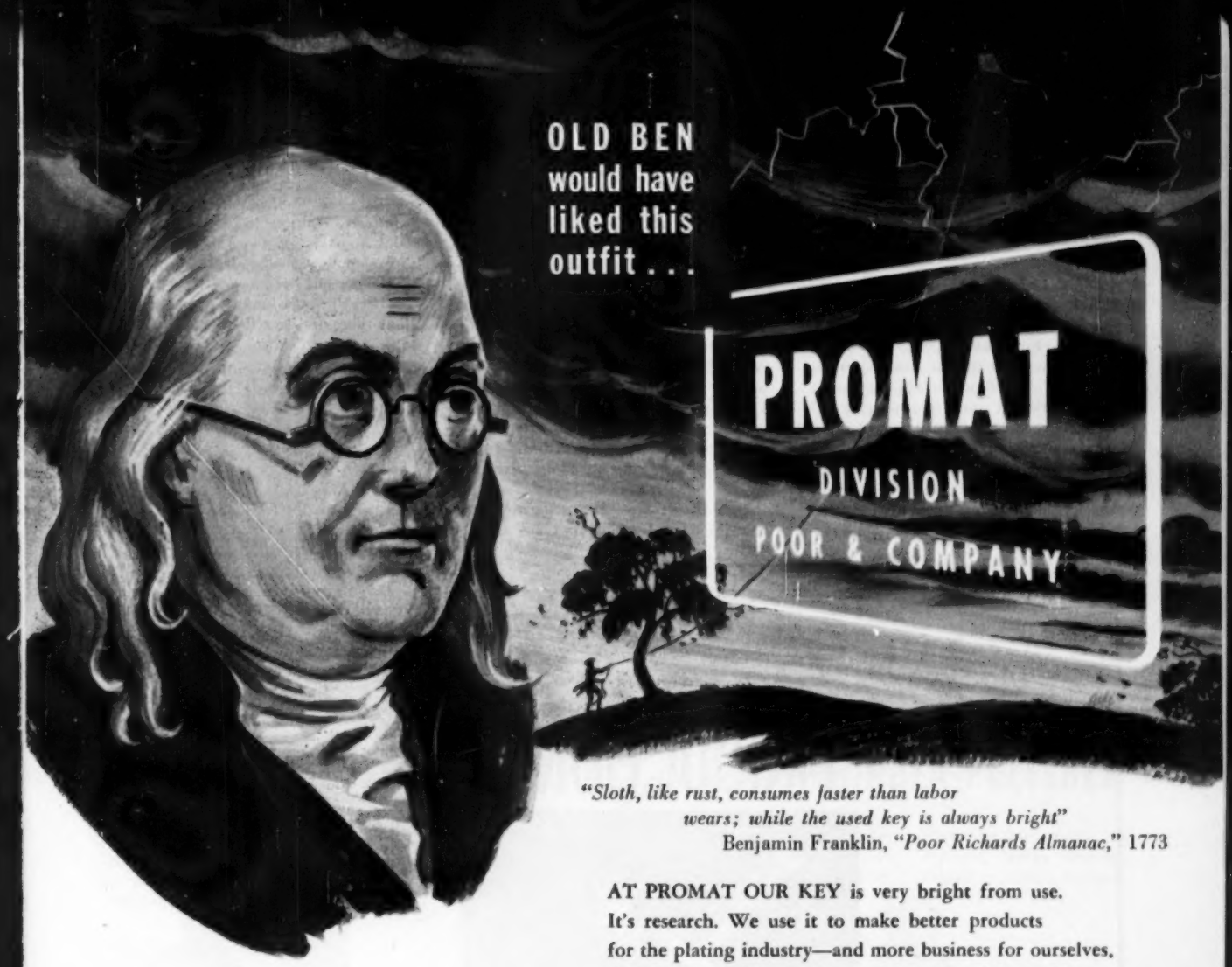
E. T. Scahill Company, Inc.
Kansas City, Missouri

W. D. Forbes Company
Minneapolis, Minn.

G. A. Stutz Mfg. Co.
Chicago, Illinois

A. T. Wagner Co.
Detroit, Michigan

Manufactured and distributed under license in Canada by Armalite Company, Ltd.
Toronto, Canada



"Sloth, like rust, consumes faster than labor wears; while the used key is always bright"
Benjamin Franklin, *"Poor Richards Almanac,"* 1773

AT PROMAT OUR KEY is very bright from use. It's research. We use it to make better products for the plating industry—and more business for ourselves. Old Ben would have approved heartily of both the method and the motive.

Like Ben, we've flown a kite, or two, into the unknown with pretty fine results—a zinc electrolyte, Promat 99M2X, that's the easiest handling available; Probrite White Alloy, a new finish and a badly needed, tested alternate for nickel. We spent seven years developing what we think are the most effective protective films for zinc-cadmium, aluminum and magnesium. These are just a few typical Promat research developments.

We've grown because, like "Poor Richard," we believe, "by diligence shall we do more with less perplexity . . . God gives all things to industry."

PREPARATION: **addition agents • iron sequestering agents • foamers**

PLATING: **acid and alkaline zinc baths • cadmium baths • cyanide copper plating processes • Probrite White Alloy • Buffing grade Probrite**

PROTECTION: **chromate films for zinc, cadmium, aluminum and magnesium**

WHAT'S YOUR PROBLEM?...
Just drop us a line for special bulletins on any of the above.

PROMAT

DIVISION
POOR & COMPANY

851 S. MARKET STREET
WAUKEGAN, ILLINOIS

INDICATE A 1023.

Personals

trial experience as a corrosion engineer. Baumgartner holds a B.S. degree in Chemistry from Muhlenberg and was previously employed by J. T. Baker Chemical Company.

Joseph A. Conlon has been appointed vice-president of the New York Belting and Packing Co., Passaic, N. J., succeeding **Ben F. Reuther,** who has retired after more than 48 years in the rubber industry. Mr. Reuther will continue in an advisory and consulting capacity.

Conlon, who will function as the company's senior operating executive, was named vice-president in charge of sales in October, 1952. He is a native of Los Angeles and has been affiliated with the rubber industry since 1930.

Reuther, a pioneer in the field of industrial rubber products, and widely known throughout the belting industry, began his long career with the Peerless Rubber Company of Passaic, N. J., in 1905. He became sales manager of New York Belting and Packing Co. in 1931 and was made vice-president in 1943.

Richard C. Martin has been named National Sales Director of Kelite Products, Inc., Los Angeles, Calif. Martin will supervise the company's service offices in 84 cities. He started with Kelite in 1944 and in 1950 was put in charge of the Southern Division with headquarters in Dallas. Martin will make his headquarters at the Kelite main plant, 1250 N. Main Street, Los Angeles.

Bruce H. Atwater has been appointed Sales Manager by Inet, Inc., Los Angeles, Calif., world's largest manufacturers of regulated selenium rectifiers. Atwater was formerly Vice-President Sales, Pacific Airmotive Corporation, Burbank, Calif.

Clem H. Hohner has been named district manager of the Udylite Corporation's southeast sales district.

Hohner has been associated with Udylite for the past seven years. Prior to that time, he was with the Scripto, Inc.,

Hohner

and Eagle Pencil Company engineering departments. He is a graduate of the Michigan College of Mining and Technology, chemical engineering school.

Hohner will also take charge of Udylite's modern new warehouse and sales office now under construction in Atlanta. These new facilities will serve plating firms in North Carolina, South Carolina, Florida, Georgia, Alabama, and eastern Tennessee.

Donald C. Starr, CPA, has been appointed secretary and comptroller of Chemsteel Construction Company, Inc.,

Starr

Pittsburgh. Starr, a graduate of Grove City College, came to Chemsteel from the Pittsburgh office of Price Waterhouse & Company, where he was a senior accountant.

Robert L. Orth was appointed Field Sales Manager by the American Wheelabrator & Equipment Corp., Mishawaka, Ind. He has 14 years' service as District Manager in the Detroit sales office of the company. **Julius E. Skene** was advanced to Manager of Customer Service, and **Philip R. Jordan** was promoted to Chief Sales Engineer.

Gordon R. Bryant was promoted to District Manager of the Detroit office. **John W. Swantz,** formerly of the firm's

Rapid fire
PRODUCTION
What with the increasing demands for munitions for our National defense, you will want to keep pace, and supply the need. NARACO scientifically designed racks and fixtures are geared to stand the speed of accelerated production and still produce perfect plating.
NARACO
INDUSTRIAL RACK CO. INC.
3462 North San Fernando Road
Los Angeles 65, Cal.
AMERICAN RACK CO. INC.
763-65 W. Root Street
Chicago, Illinois
IMPERIAL RACK CO. INC
1109 E. Stewart Avenue
Flint, Michigan
NATIONAL RACK CO. INC.
179-181 Madison St.
Paterson, N. J.

Chicago office, joined the Detroit office as a District Sales Engineer, and **Erwin C. Shepard** was added as a Service Engineer.

F. H. Toman was appointed District Sales Engineer to replace Mr. Swantz in the Chicago office. He was formerly District Service Engineer in the Toronto, Ontario, office. **J. Douglas Lamb** was appointed District Service Engineer for the Toronto office.

Also announced was the appointment of **Wilfred G. Carrie** as District Manager of the Seattle office. He was formerly a home office project engineer in the company's Dust & Fume Control Division. **George C. Tolton,** former Seattle District Manager, has been appointed District Manager of the Greensboro, N. C., branch.

E. A. Warnecke, J. B. Rogers and **W. E. Gilroy** have been added to The Diversey Corporation's Metal Industries Department as sales representatives.

Warnecke Rogers

Gilroy

Warnecke now represents Diversey in Milwaukee and the state of Wisconsin. He has had previous sales experience in metal and related fields and is a graduate of the University of Wisconsin where he received his B.S. degree in Economics.

Rogers is the sales representative in the Cleveland area. He attended Ohio Northern University receiving his degree in Business Administration, and since has gained a wealth of experience in selling.

Gilroy has taken over as sales representative in the state of Connecticut. He is a graduate of Cornell University. His diversified sales background makes him ideally suited to his new position.

Westley J. Tuite, formerly Chicago District Manager, has been promoted to the position of general sales manager by W. H. Brady Company, 727 W. Glendale Ave., Milwaukee 12, Wis. Tuite will headquarter at the Company's main office in Milwaukee.

Fred C. Kluhsman has been appointed Chicago District Representative, headquartering in Chicago and **Joseph I. Stone,** formerly Eastern District Representative, was named Eastern District Manager, with headquarters at the Company's Branch Office in Newark, N. J.

Paul J. Leonard, appointed Mideastern District Representative, will headquarter at Philadelphia.

John B. Calkin, chemical engineer and consultant with offices in New York City, has been named assistant to the president, Foster D. Snell, Inc., of 29 W. 15th St., New York. He will also be director of market research. This appointment follows a long time connection of Mr. Calkin with the firm. He has recently been associated with the University of Maine where he was director of the Department of Industrial Cooperation and Secretary, University of Maine Pulp & Paper Foundation.

Leonard E. Petzinger has been appointed sales engineer for the Cleveland area for the Industrial Filtration Division of the U. S. Hoffman Machinery Corporation, Syracuse, N. Y. This is in addition to the Cincinnati area which he has served for the past year and a half. Offices will be maintained in both cities. Before entering the sales field for U. S. Hoffman more than two years ago, Petzinger had broad experience in metal working production and plant operation.

Hammond OF KALAMAZOO
GOOD MACHINERY SINCE '82

MODERN *Self Contained* GRINDER-POLISHER

Hammond Variable Speed (1500 to 3000 RPM) Polishing and Buffing Lathe. Models up to 50 HP available.

Hammond Cyclone Duskolector. One of a wide line of Cyclone and Filter Types.

Hammond Backstands. 10 Air and Spring Tension Models to choose from.

Write for Catalog No. 60 showing America's most modern and complete line.

Hammond Machinery Builders INC
1613 DOUGLAS AVENUE • KALAMAZOO, MICHIGAN

Trade Literature

L—900. Measuring Equipment Catalog—A revised edition of the General Electric Company's 64-page measuring equipment catalog, containing information on more than 115 testing and measuring devices for laboratory and production line use, has been announced as available from the Company at Schenectady 5, N. Y.

The fully illustrated publication, GEC-1016A, contains information on products ranging from simple current indicators to completely automatic oscillographs; from surface roughness scales to mass spectrometers; from d-c amplifiers to radiation monitors. For your copy of this descriptive catalog, use Reader Service Card.

L—901. New "Teflon" Technical Bulletin—Latest word on woven glass fabrics impregnated and coated with "Teflon" tetrafluoroethylene resin is available in a new technical bulletin compiled by the Du Pont Fabrics Division.

Not only are the outstanding electrical and mechanical properties of these fabrics, tapes and laminates set forth in tabular form, but uses in other fields are also touched upon. The chemical and solvent resistance, high and low temperature characteristics, and anti-adhesive and anti-friction properties of various glass fabrics coated with "Teflon" suggest applications in the aircraft, chemical, plastics, and other industries.

Copies are available on request to Du Pont Co., Fabrics Division, Room P-812, 350 Fifth Ave., New York, N. Y., or through use of Reader Service Card.

L—902. Instrumentation for Industry Spotlighted—The growing importance of instrumentation to nearly every modern industry, large or small, is dramatized by actual case histories appearing in the latest "Beckman Bulletin", house magazine of Beckman Instruments, Inc.

Instruments for analyzing flame color, electrometric control of *p*H are featured in this new issue plus a colorful story of "seagoing" spectrophotometers and *p*H meters.

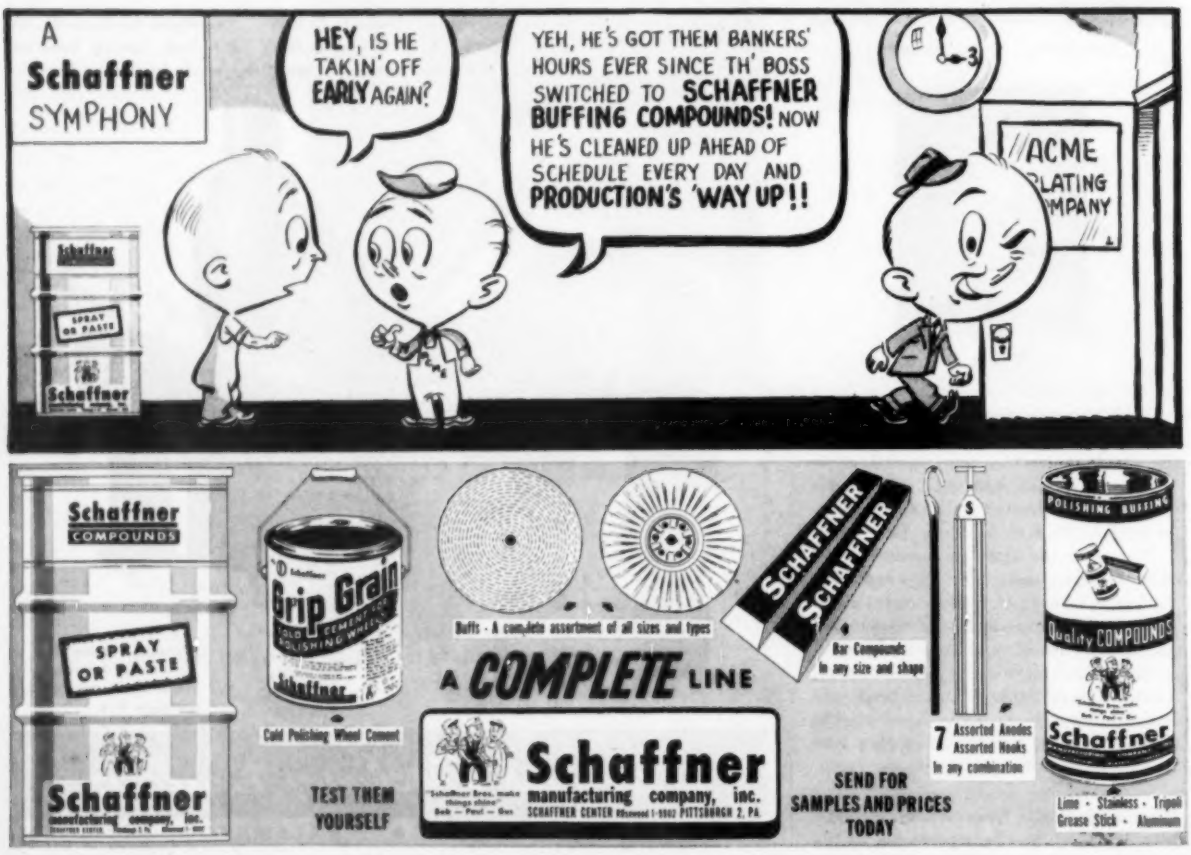
New instruments discussed include a high-speed automatic strain gage recorder capable of monitoring up to 200 check points in five minutes. A precision low-cost micro-microammeter for measuring minute currents in such work as nuclear radiation is also described.

Copies of this informative 8-page magazine can be obtained from Beckman Instruments, Inc., South Pasadena 1, Calif., through requests for BB-11-72, or through use of Reader Service Card.

L—903. Tygorust Fact Sheet—The U. S. Stoneware Company has released a data sheet on Tygorust the "no-prep" vinyl primer for wet or dry rusted steel, for wood or for concrete. The product virtually eliminates surface preparation, goes under any type finish, dries hard in minutes, resists and inhibits rust formation and gives excellent adhesion. Where and how to use the material is outlined and what to use with it as a top coating is described. For your copy of this informative literature, use Reader Service Card.

L—904. Dynel Fabric Filter Mat—Dynel Windsor felt, a new type of chemically resistant, fiber-bonded filter fabric, was introduced recently by the American Felt Company, Glenville, Conn.

The new Dynel material was developed as a superior filter mat for use in filter press or vacuum filter applications for highly efficient cake formation or clarity of filtrate. Typical filtration uses are for dyestuff manufacture, clarifying of electroplating solutions, production of chemi-


A Schaffner SYMPHONY
HEY, IS HE TAKIN' OFF EARLY AGAIN?
YEH, HE'S GOT THEM BANKERS' HOURS EVER SINCE TH' BOSS SWITCHED TO SCHAFFNER BUFFING COMPOUNDS! NOW HE'S CLEANED UP AHEAD OF SCHEDULE EVERY DAY AND PRODUCTION'S 'WAY UP!!
ACME PLATING COMPANY
Schaffner
SPRAY OR PASTE
Schaffner
Schaffner COMPOUNDS
SPRAY OR PASTE
Schaffner manufacturing company, inc.
Grip Grain
COLD CEMENTING POLISHING WHEEL
Schaffner
Cold Polishing Wheel Cement
TEST THEM YOURSELF
Buffs - A complete assortment of all sizes and types
A COMPLETE LINE
"Schaffner Bros. make things shine" Bob — Paul — Gus
Schaffner manufacturing company, inc.
SCHAFFNER CENTER PITTSBURGH 2, PA.
SCHAFFNER
SCHAFFNER
Bar Compounds in any size and shape
7 Assorted Anodes Assorted Hooks In any combination
SEND FOR SAMPLES AND PRICES TODAY
POLISHING BUFFING
Quality COMPOUNDS
Schaffner
Lime · Stainless · Tripoli
Grease Stick · Aluminum

Brand New!

FOR BETTER BUFFING

The Nankervis Air-Operated Automatic Compound Applicator

X STROKES PER MINUTE

(X . . . The number of strokes your buffing operation calls for—indexed by work, platen, electric timer, foot switch, cam, etc.)

You, too, can cash in on all of the advantages of automatic compound application—earn substantial savings in material and time; have a cleaner buffing department as well.

The Nankervis air-operated automatic compound applicator provides all of these advantages and more!

Because it is flexible, you use compound only when it's needed. The number of times the compound actually touches the wheel depends upon the buffing operation involved. *That, alone, adds up to real savings.* The applicator is actuated either mechanically, electrically or manually; feeds just the right amount of compound; not too much, not too little.

It's ideal for multiple operation, too. All the applicators on an entire buffing line can be operated simultaneously from a single three-way valve.

The entire story is contained in the new Nankervis booklet covering the air-operated compound applicator. Write for Bulletin No. 6-600—*today!*

GEORGE L. Nankervis COMPANY

EQUIPMENT AND SUPPLIES FOR THE METAL FINISHING INDUSTRY

19255 WEST DAVISON AVENUE • DETROIT 23, MICHIGAN

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1027.

Trade Literature

cals and food products. A fact sheet that details complete data on the new product is available. For your copy use Reader Service Card.

L—905. Vacuum Pump Paper—Dr. Richard B. Lawrance, Director of the Applied Physics Department at National Research Corporation, Cambridge, Mass., has presented a paper, published as "High Vacuum Vapor Pumps", discussing many of their important characteristics. He has presented a practical means of correlating these factors for industrial applications. Among the factors and characteristics discussed are the lowest obtainable pressure, volumetric speed, inlet pressure, through-put, limitations of high inlet pressures, and maximum forepressures. Dr. Lawrance discusses a graphical presentation of these quantities which permits correlation for industrial use. Reprints of the paper are available. Use Reader Service Card.

L—906. Adhesives, Coatings and Sealers Guide—A new handy guide to selection of industrial adhesives, coatings and sealers is now available from The Adhesives and Coatings Division, Minnesota Mining and Manufacturing Company, 432 Piquette Ave., Detroit 2, Mich. The two-color, eight-page bulletin titled, "Adhesives, Coatings and Sealers", lists the most important adhesives, coatings and sealers which 3M produces in such a manner as to enable the reader to determine at a glance what type of product is best suited to his particular manufacturing problem.

For your copy of this guide, use Reader Service Card.

L—907. Dust and Paint Hoods—Protective hoods designed especially for use with Mine Safety Appliances Company's dust, paint and chemical respirators are pictured and described in a new two-page bulletin.

Catalog information is included to facilitate ordering protective hoods and respirators together, the hoods alone, or replacement parts. Copies of the bulletin may be obtained by using Reader Service Card.

L—908. Packing Compound Bulletin—Surveys, Inc., 219P Euclid Ave., Trenton 9, N. J., have issued a bulletin which fully describes their material, Molyseal, a metallo-plastic sealing and packing compound for steam, water, compressed air applications in valves, expansion joints and pumps. The material is a self-molding packing sealing compound that eliminates large packing inventories insofar as styles and sizes are concerned. For your copy of this engineering and specifications bulletin use Reader Service Card.

L—909. Material Handling Booklet—A two-color illustrated booklet showing different units in the new and revolutionary Work-O-Matic material handling system has just been published by The Union Metal Manufacturing Company of Canton, Ohio.

On-the-job photographs show material positioning with bin boxes and gravity-fed hoppers, and tiering, storing and dumping with multi-duty boxes and trays. Picture stories describe how end-loading scoops and multi-duty trays go further in integrating production, storage, material movement and disposal than was previously thought possible with container-type units.

Copies may be obtained by using Reader Service Card.

L—910. Bulletin on Rubber Hose Care—A new bulletin on the care of rubber hose called "Tips on Hose Care" tells what to do and what not to do in the use and storage of various kinds of hose, including steam, fire, oil, gasoline, water, air, suction and sandblast hose.

A copy of the bulletin may be obtained by writing to Hewitt-Robins Incorporated, 240P Kensington Ave., Buffalo, or by using Reader Service Card.

L—911. Salt Tablet Dispenser Bulletin—Salt tablet dispensers, both permanent and throw-away types, and salt tablets and combination tablets are described in a new two-page bulletin from Mine Safety Appliances Company, Pittsburgh, Pa.

One page is devoted to the 1-4-U Throw-Away Salt Tablet Dispenser and various types of tablets, including salt,

BRASS PLATING WITH TRUE BRITE

❶ improve color

❷ save labor

❸ eliminate supervision

❶ *color stays constant . . . no rejects*

❷ *eliminates frequent analyses . . .*

❸ *trouble free . . . only one addition instead of three*

Write for FREE bulletin! Your key to better Brass Plating

Available in regular 3 to 1 ratio for yellow Brass Plating.

Special ratio materials for plating richlow brass or any other desired alloy of copper and zinc.

Suitable for both still tanks and barrels.

TRUE BRITE CHEMICAL PRODUCTS CO.
P. O. Box 31, Oakville, Conn.

salt-and-dextrose combination, enteric-coated and impregnated. The other page illustrates and describes the permanent salt tablet dispensers, including bakelite and translucent plastic models.

Copies of the new bulletin are available through use of Reader Service Card.

L—912. Plating Processes Folder—The development of new methods for volume electroplating of intricate precision components with precious and common metals while holding to closest tolerances has been announced by American Electro Products, Inc., 1358 Thomaston Ave., Waterbury, who have issued a descriptive folder.

The new techniques, known as the "Cantavone" controlled processes, are designed to plate components with the required number and type of electrodeposits in volume hitherto considered impractical and at less cost than conventional methods.

The processes resulted from ten years of research while plating components for Government and industrial applications.

The new techniques have proved practical in volume plating intricate components with as many as five electrodeposits controlled to exceptionally close tolerances.

For your copy of the descriptive folder use Reader Service Card.

L—913. Selenium Rectifier Booklet—The Type K Magamp selenium rectifier is described in an 8-page booklet available from the Westinghouse Electric Corporation, Pittsburgh 30, Pa.

First sections of the booklet give a definition of selenium rectifier terms and electrical characteristics. A number of graphs are included showing reverse current leakage limits and forward current-voltage drop under various conditions.

Tables, formulas and examples are provided to aid in the selection of the physical dimensions for any particular cell size and cell combination.

For a copy of this booklet use Reader Service Card.

L—914. Mixed-Bed Demineralizer Bulletin—Barnstead Still & Sterilizer Co., 228 Lanesville Ter., Forest Hills, Boston 31, Mass., announces the publication of a new bulletin on mixed-bed water demineralizers.

The bulletin explains in text and pictures how a mixed-bed demineralizer operates in producing high-purity water by ion-exchange method. Special stress is laid on the recent development of Barnstead's simplified, positive regeneration system, which separates resins quickly and surely and then remixes them for efficient mixed-bed performance. The new bulletin may be obtained by writing to Barnstead or by using Reader Service Card.

L—915. Rigid PVC Pipe Bulletin—A new bulletin describing a new extruded rigid polyvinyl chloride pipe and tubing in a wide range of sizes and a full line of fittings has just been issued by Alpha Plastics, Inc., 14 Northfield Rd., West Orange, N. J. Detailed physical properties, bursting strengths and other important data are included. For your copy use Reader Service Card.

L—916. High Vacuum Pump Catalog—A new, extensively revised edition of the 36-page catalog, "Stokes Microvac Pumps for High Vacuum", has just been issued by F. J. Stokes Machine Company, 550 Tabor Rd., Philadelphia 20, Pa. The new catalog, No. 750, includes valuable tables of formulas, constants, and conversions frequently used in vacuum processing; solutions to problems of pump selection for typical vacuum systems; and useful information on continuous oil purification and other maintenance procedures for high vacuum pumps. For your copy, use Reader Service Card.

L—917. Finishes for Aluminum—Just off the press is Reynolds Metals *Technical Advisor* No. 21, which features an article on designing with aluminum.

Also presented is the third in a series of articles on "Finishes for Aluminum". Reynolds 1953 edition of its technical manual on Welding, Brazing, and Soldering of Aluminum is also reviewed.

The question-and-answer page features information on joining tube ends, soldering aluminum, infra-red reflectivity, aluminum arrows, terrazzo floor strips, storing alloys, and forming springback.

Copies of this literature are available by using Reader Service Card.

HAVEG
Trade Mark Reg. U.S. Pat. Off

MOLDED TANKS
built to STOP CORROSION

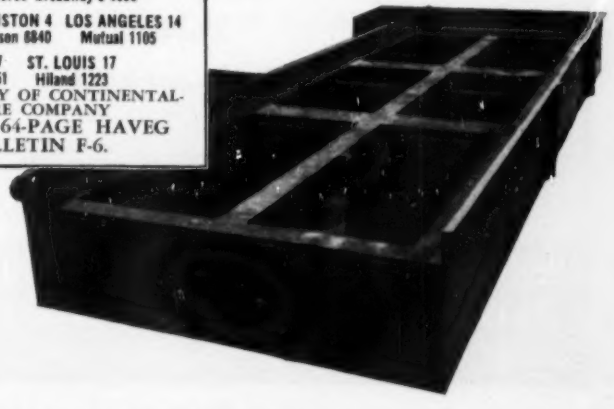
Does corrosion eat into your profits, contaminate your products, increase your maintenance costs? Haveg, the plastic material most effective against corrosion, will solve your problems. It can be custom-engineered to fit your requirements. Haveg is not a lining or coating, but a moldable, thermosetting plastic made of acid-digested asbestos and special resins that resist acid, alkali, solvent, corrosion. Haveg tanks last for years and years . . . even when used continuously in temperatures as high as 265 degrees F., with a good margin of safety.

In addition to its remarkable corrosion-resistance, Haveg is strong; has low heat conductivity (seldom requires insulation); and can be repaired, altered or machined on the spot. Haveg Corporation has both the molds and experience to make tanks quickly . . . in any style, size, baffle design to fit your needs. Pipe (plain or perforated), fume duct, pumps, valves, heat exchangers also are made by the Haveg Corporation. For engineering assistance, complete information about Haveg, call your Haveg sales office. Write today for 64-page descriptive Bulletin F-6.

PUMPS TANKS PIPE

HAVEG
Trade Mark Reg. U.S. Pat. Off.
CORPORATION*
NEWARK, DELAWARE
FACTORY: MARSHALLTON, DEL.
Wilmington 3-8884

ATLANTA Exchange 3821 CHICAGO 11 Delaware 7-6088 CINCINNATI 37 Valley 1610
CLEVELAND 20 Washington 1-8700 DETROIT 35 Broadway 3-0880
HARTFORD 5 Hartford 6-4250 HOUSTON 4 Jackson 6840 LOS ANGELES 14 Mutual 1105
SEATTLE 7 Hemlock 1351 ST. LOUIS 17 Hiland 1223
* A SUBSIDIARY OF CONTINENTAL-DIAMOND FIBRE COMPANY
SEND FOR 64-PAGE HAVEG BULLETIN F-6.



INDEX OF ACP CHEMICALS FOR METAL PRESERVATION AND PAINT PROTECTION

METAL	OPERATION	ACP CHEMICAL
ALUMINUM	Cleaning	"DEOXIDINE" "DURIDINE" "ACP RIDOLINES AND RIDOSOLS"
	Preparation for Painting	"ALODINE" "DURIDINE" "DEOXIDINE"
	Protection from Corrosion	"ALODINE"
GALVANIZED IRON, ZINC, AND CADMIUM	Cleaning	"DURIDINE" "ACP RIDOLINES AND RIDOSOLS"
	Corrosion Proofing	"ZINODINE"
	Paint Bonding	"ZINODINE"
	Phosphate Coating, in Preparation for Painting	"LITHOFORM"
	Soldering Flux	"FLOSOL"
STEEL	Chromate Coating, in Preparation for Painting	"CROMODINE"
	Cleaning	"ACP RIDOLINES AND RIDOSOLS"
	Cleaning for Painting	"DEOXIDINE" "DURIDINE"
	Coating with Copper	"CUPRODINE"
	Drawing and Extrusion	"GRANODRAW"
	Paint Bonding	"CROMODINE" "DURIDINE" "GRANODINE" "PERMADINE" "THERMOIL-GRANODINE"
	Paint Stripping	"CAUSTIC SODA AND SOLVENT NO. 3"
	Phosphate Coating, in Preparation for Painting	"DURIDINE" "GRANODINE" "PERMADINE" "THERMOIL-GRANODINE"
	Phosphate Coating, to Protect Friction Surfaces	"THERMOIL-GRANODINE"
	Pickling with Inhibited Acids	"RODINE"
	Rust Prevention for Unpainted Iron	"PEROLINE"
	Rust Proofing	"PERMADINE" "THERMOIL-GRANODINE"
	Rust Removal—Brush, Dip, or Spray	"DEOXIDINE"
	Soldering Flux	"FLOSOL"

Visit Our Display in
Space 1104
Main Exhibition Hall
Cleveland
Public Auditorium
at the
National Metal Exposition
October 19th - 23rd

CHEMICALS ACP PROCESSES

AMERICAN CHEMICAL PAINT COMPANY

GENERAL OFFICES: AMBLER, PENNSYLVANIA

Detroit, Michigan Niles, California Windsor, Ontario

Mail Box

Subject: Expanding the Scope of the A.E.S.

DEAR SIR:

I was very interested to read the comments of Mr. Leonard Weeg in your May, 1953 issue, and your editorial remarks regarding the need for the extension of the scope of the A. E. S. to include also finishing techniques other than electroplating.

This is a problem which we have had to face in this Institute over the last two years, and it has proved necessary to deal with it by the drastic measure of changing the name of the Electrodepositors' Technical Society to the Institute of Metal Finishing to meet the full needs of the industry.

The application of organic and related finishes has become a subject all on its own and there has hitherto, in this country at any rate, been no suitable forum for the discussion of the processes concerned. The scientific and technical bodies dealing with paints are principally interested in the manufacturing side of the business and their membership has always consisted largely of people having only a secondary interest in paint application.

As a start we have, therefore, formed in London an Organic Finishing Group, which will have its own programme and which is organizing a series of interesting meetings and conferences. There is a large amount of available material suitable for papers and discussions, and there will be no difficulty in organizing meetings on the vast range of subjects with which metal finishing is concerned quite apart from electroplating. Additionally, the local branches of the Institute are incorporating at least one meeting on organic finishes on their programme for the coming season.

I feel sure that the A. E. S. would do well to broaden its scope on similar lines; this would not only meet the real needs of a large number of your members but would introduce a new group of members, both corporate and individual, thus strengthening the Society financially.

In industry today it is necessary for platers to have a wide outlook and to take an interest in every aspect of finishing; organic finishes must be regarded as complementary to, rather than competitive with, electroplating, and there are other processes coming along which they must be familiar with also.

As I have for many years personally taken the keenest interest in the work of the A. E. S. I should very much like to see the Society develop on these lines and would take the opportunity of wishing it every success in the future.

H. SILMAN,
President, Institute of Metal Finishing

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1030.

Cleaning Specialists

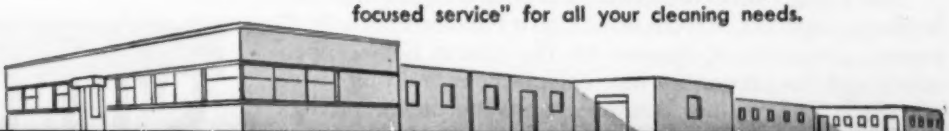
SERVING YOU SINCE '32

Top manufacturers, who know the value of good cleaning, know they can find the right process for preparing any metal surface for finishing at Northwest—

- **LO-HI pH PROCESS—for cleaning prior to plating, painting, or porcelain enameling.**
- **ALKALUME PROCESS—for preparing aluminum for finishing and spot welding.**
- **INTERLOX PROCESS—for phosphate coating.**
- **SPRA-LUBE—to control the over-spray of "today's" paints in water-wash paint-spray booths.**
- **PAINT STRIPPERS—specific to your needs.**
- **SUPER-DRAW & FLUID-FILM—for drawing metals.**

Get Northwest's specialized products plus "job-focused service" for all your cleaning needs.

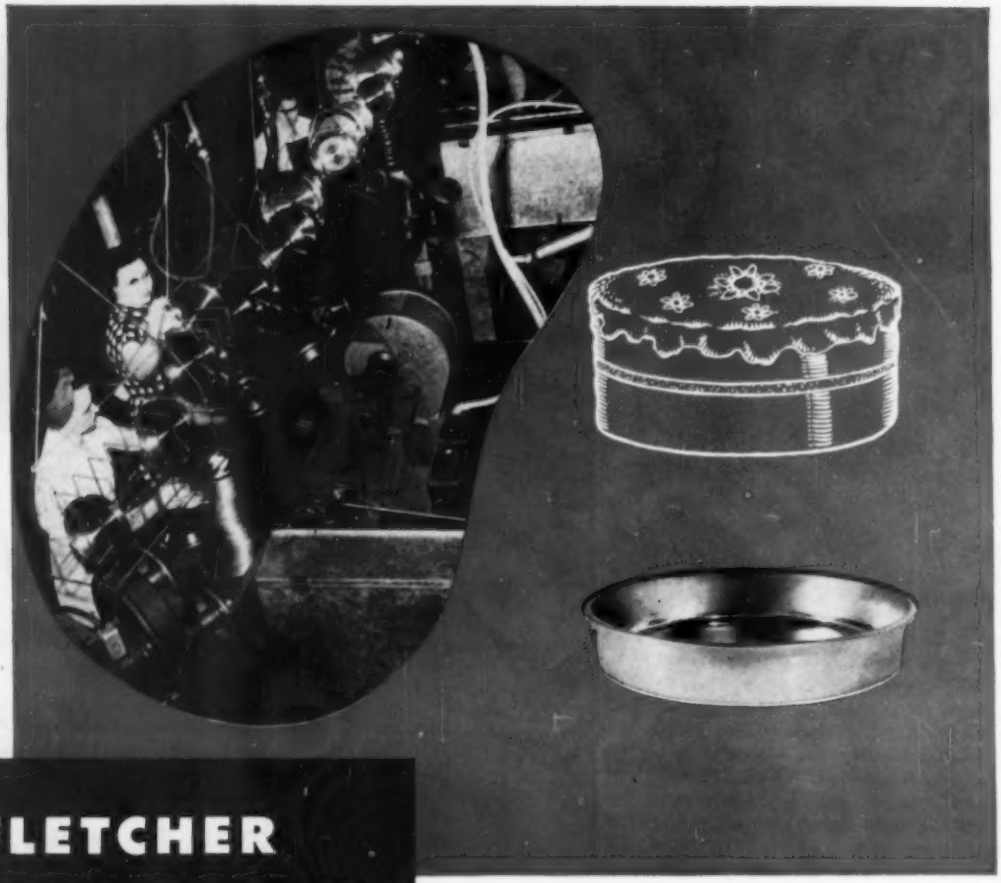
Got a problem? Let our cleaning experts help you!



NORTHWEST CHEMICAL CO.

9310 ROSELAWN DETROIT 4, MICH.

pioneers in pH cleaning control *serving you since '32*



FLETCHER
NOW GETS THE BEST FINISH AT LOWEST COST... THANKS TO STEVENS L-V* REPORTS!

The Fletcher Enamel Company, Dunbar, West Virginia, wanted a top-quality finish for stainless steel cake pans and oven top products.

They brought their problems to Stevens.

After trying many combinations of compositions, buffs and buffing equipment, Stevens submitted a Laboratory-Verified* report. Automatic equipment for the critical buffing operations and the correct Stevens compositions and buffs were specified. Today, this company turns out their product quickly, economically . . . with exactly the finish they want.

Let a Stevens L-V Test Report show you the right way — equipment, compositions and buffs to solve your buffing problems. There's no obligation, of course!

**Laboratory-Verified*

See us at National Metal Exposition
Cleveland, Ohio • October 19-23
Booths 2547-55

FREDERIC B.
STEVENS
INCORPORATED
YOUR METAL FINISHING SUPERMARKET
DETROIT 16, MICHIGAN

BRANCHES: BUFFALO • CLEVELAND • INDIANAPOLIS • NEW HAVEN
IN CANADA: FREDERIC B. STEVENS OF CANADA, LTD., TORONTO • MONTREAL • WINDSOR

Staff

Managing Editor
P. PETER KOVATIS

Editor
A. KORBELAK

Editorial Board
J. M. Andrus, E. R. Bowerman, L. Diveley, F. Fulforth, W. Geissman, D. Gray, W. R. Meyer, L. M. Morse, M. Nadel, C. W. Ostrander,

Advertising Manager
W. C. DIETRICH

LEE F. O'CONNELL, Western Representative (111 N. La Cienega Blvd., Beverly Hills 48, Cal f.; 544 Russ Bldg., San Francisco 4, Calif.)

Production Manager
M. K. DICKINSON

This month's cover is an aerial view showing Columbia University where work on A.E.S. Research Project No. 12 is being conducted.

Published by the American Electroplaters' Society. Publication Office: 5800 N. Marvine Street, Philadelphia 41, Pa. Phone: LIvingston 8-7800. Editorial, Advertising and Executive Offices: American Building, 445 Broad Street, Newark 2, N. J. Phone: Humboldt 2-3400. Subscriptions: Domestic and Canada, $4.00 for 1 year; $7.00 for 2 years; 50c per copy; Foreign, $8.00 per year; $1.00 per copy.

Copyright, 1953, by the American Electroplaters' Society.

PLATING is abstracted regularly in Chemical Abstracts, Metallurgical Abstracts, Engineering Index, Technical Data Digest and Bulletin Analytique.

plating

Dedicated to the improvement and dissemination of the knowledge of the arts and sciences of electroplating and of finishing of metals and of allied arts.

SEPTEMBER, 1953 VOL. 40, No. 9

Contents

Black Chromium-Base Electroplating 982
Martin F. Quaely

Crack-Free Chromium from Baths of the Self-Regulating High-Speed Type 987
R. Dow and J. E. Stareck

Cost Determination in the Industrial Chromium Plating Job Shop 1001
W. F. Walton and P. B. Lonsbury

Stability of Ion Exchange Resins Toward Chromic Acid Plating Solutions 1005
C. F. Paulson and G. H. Saunders

A. E. S. RESEARCH REPORT:
Porosity of Electrodeposited Metals. XI. Analysis of Corrosion Products as a Method of Measuring the Change of Porosity in Corrosion 1011
N. Thon, Ling Yang and Stella Yang

Branch Speakers List—1953–1954 (additions) 1044

Monthly Features

Advertising Index 1051
A. E. S. Directory 1048
Article Abstracts 1026
Book Review 1016
Branch News 1042
Editorial 981
Equipment and Supplies 1018
Future Meetings 1052
Industry News 952
In This Issue 948
Mail Box 976
Membership Report 1046
Patent Abstracts 1032
Personals 966
Question Box 1010
Society News 964
Trade Literature 972

HARSHAW ANODES and CHEMICALS

You can depend on Harshaw products to keep your production moving. For more than fifty years we have concentrated on improving the quality of the anodes and chemicals used by platers.

NICKEL PLATING

. . . still and barrel . . . nickel anodes—all commercial grades and sizes . . . anode bags . . . single nickel salts—nickel chloride . . . nickel carbonate . . . nickel fluoborate . . . boric acid.

CHROMIUM PLATING

. . . pure "Krome Flake" 99.8% CrO_3 . . . sulphates less than .10% . . . lead, tin-lead and antimony-lead anodes.

COPPER PLATING

. . . copper ball anodes . . . Rochelle Salts . . . sodium and copper cyanides . . . copper sulfate . . . copper fluoborate.

CADMIUM PLATING

. . . ball and cast cadmium anodes . . . cadmium oxide . . . sodium cyanide . . . cadmium fluoborate.

TIN PLATING

. . . cast tin anodes . . . sodium stannate . . . stannous sulfate . . . tin fluoborate . . . acid tin addition agent.

ZINC PLATING

. . . ball and cast zinc anodes . . . sodium and zinc cyanide . . . zinc sulfate . . . zinc fluoborate.

LEAD PLATING

. . . cast lead anodes . . . lead fluoborate.

SILVER PLATING

. . . silver cyanide.

The HARSHAW CHEMICAL Co., Cleveland 6, Ohio

Chicago 10, Ill. • Cincinnati 13, Ohio • Detroit 28, Mich. • Houston 11, Texas
Los Angeles 22, Calif. • Philadelphia 48, Pa. • Pittsburgh 22, Pa. • New York 17, N.Y.

Editorial

. . . For Creative Achievement

A REVIEW of the contemporary crop of isms shows the undesirable results of their tampering with the objective findings of scientific groups. The presence of such a recent lesson gives added emphasis to the danger inherent in the apparent attempt to pressure a favorable report out of the highly respected National Bureau of Standards.

In a resolution adopted at Philadelphia recently, the American Electroplaters' Society recognized such a challenging peril. The Society's Delegates deplored "the unfortunate reflection on the integrity of both the director of the Bureau of Standards and the Bureau of Standards staff of scientists contained in the unwarranted dismissal and subsequent clouded reinstatement of Dr. Allen V. Astin, and urged not only that the results of a thorough impartial investigation be made public as soon as possible but also that prompt congressional consideration be given to legislation designed to minimize the possibility in the future of similar actions, so devastating with regard to personnel morale and Bureau prestige."

By this action, the voice of the A. E. S. membership is added to the already voluminous protests of other technical groups—voices calling for the preservation of intellectual freedom, one of the fundamental freedoms necessary for creative achievement.

Al Korbelak

BLACK CHROMIUM-BASE ELECTROPLATING*

MARTIN F. QUAELY†

Abstract

A number of solutions have been developed for the production of black coatings that have good adherence to the base-metal. These deposits will withstand heating in high vacuum to temperatures of over 930° F (500° C) and can be applied to most metals without the use of special equipment. The new black electrodeposits are basically metallic chromium. They also contain vanadium or nickel or both. The deposits consist of finely divided metal and oxide. From a bath containing chromic acid and nickel salts a silvery deposit results, which is changed to black upon treatment with hydrochloric acid. A second bath contains chromic acid, vanadium salts, and nickel salts. A third contains chromic acid and vanadium salts. Black deposits are obtained directly from the latter two baths. A very small amount of a carboxylic acid is added to each solution to extend operating conditions. The baths are operated at current densities of 695–1850 amp/ft² (75–200 amp/dm²), and at temperatures of 86–131° F (30–55° C).

Introduction

For some time there has been considerable demand for black finishes possessing good adherence, heat resistance, and black-body properties. Particular situations have arisen wherein a black finish was required for electron tube parts, for bimetal heater elements, and for stainless steel parts of various sizes and shapes for industrial applications.

Paints and lacquers of specific compositions have been used from time to time, but such finishes were invariably unsuitable for a number of reasons. For the most part, they did not resist moderately high temperatures, and their thickness could not be controlled.

Fortunately, there are available a number of methods for producing black finishes on metals. Oxide finishes, especially, have found extended use in a large number of industries. Black oxide coatings can be produced by immersion of the metal article to be coated in a suitable oxidizing solution[1,2,3]. There are also the phosphate type baths[4,5] for producing black coatings. In addition, there are a number of electrochemical procedures for obtaining black finishes. It is with this latter type that this paper is concerned.

Experimental

Probably the most durable of all the electrodeposited black finishes are the chromium-base plates. They are stable in vacuum and in air. They have fairly good corrosion resistance, and their mechanical properties are superior to those of other black finishes. For some years, black deposits have been obtained by electrodeposition from a chromic acid solution[6,7,8]. A similar method has been proposed within the past year by Gilbert and Buhman[9].

There have been numerous industrial demands for a uniform black coating which would withstand heating in high vacuum, such as prevails in certain parts of electron tubes 750–930° F (400—500° C). Furthermore, the coatings had to have low vapor pressures. Black chromium plating was suggested as a method of obtaining the required finish. Experiments were conducted on a number of plating solutions, with a fair degree of success in most cases.

A straight chromium bath was used first. While a black plate was generally obtainable, the process had to be controlled within very narrow limits in order to get an acceptable deposit. It was quite important to provide cooling for the plating solution in order to remove the excess heat produced by the high power input. The temperature of the bath had to be maintained below 77° F (25° C). At higher temperatures the quality of the plate was seriously affected. If the current density was too high, "treeing" occurred and the deposit was rough and had a tendency to be off-color.

In an attempt to obtain some improvement over the straight chromium bath, various metallic ions were added which, it was believed, would increase the stability of the plate from the standpoint of both temperature and corrosion. Among these metal additions were nickel and vanadium.

*Presented at the Fortieth Annual Convention of the American Electroplaters' Society, June 16, 1953.

†Engineer, Westinghouse Electric Corp., Research Department, Lamp Division, Bloomfield, N. J.

Chromium-Nickel Electrolyte

When nickel ion was added to the chromium bath and plating was carried on under the conditions usually necessary to obtain a black finish, no black deposit was obtained under a wide range of current densities. The plating bath contained chromic acid and nickel chloride in a ratio of 10 parts chromic acid (CrO_3) to 1 part nickel chloride ($NiCl_2.6H_2O$), the actual amounts being chromic acid 26.8 oz/gal (200 g/l), and nickel chloride 2.68 oz/gal (20 g/l). An addition of about 0.65 fluid ounces of glacial acetic acid per gallon of solution (5 ml per liter) was also made to extend operating conditions and prolong the operating life of the solution. A ratio of about 20 parts chromium to 1 part nickel was found to give optimum results.

With the chromium-nickel solution and at a current density of 695–1850 amp/ft^2 (75–200 amp/dm^2), bright and silvery deposits were obtained. As the coatings were applied in heavier thicknesses it was noted that they became coarser in texture. These silvery deposits were fairly hard. A copper rod with an annealed micro-hardness of 91 Knoop (100-gram load) was plated in this bath. The plate had a micro-hardness of 530 Knoop (100-gram load). The deposit was attacked only slowly by cold hydrochloric and sulfuric acids, although it could be dissolved eventually. Nitric acid had practically no effect on the coating. There was no blistering of the plate when heated to dull red heat. However, a slight oxidation of the surface was evident.

Spectrographic analysis of these silvery deposits showed the presence of chromium and nickel. From work done by Brenner et al[10] at the National Bureau of Standards it would appear that there are undoubtedly chromium oxides present in the deposit. Spectrographic analysis has shown the chromium and nickel to be present in about the same proportions as in the plating bath. Without the nickel in the bath, no silvery deposit was obtained.

By plating metal parts in this chromium-nickel bath it is possible to build up thicknesses of plate very rapidly. For instance, a ¼ inch copper rod, 4 inches long, was plated for five minutes. A plate of 0.001 inch thickness was obtained.

When this silvery deposit was treated with concentrated hydrochloric acid for about 5 to 30 seconds, the silvery appearance disappeared and a black finish remained. This black finish that was obtained is best described as a blue-gray black, in other words, not a jet black. However, it can be used in many instances where a stable black finish is required. It will not smudge off when vigorously rubbed by hand, and it is very adherent and stable.

In order to determine whether nickel sulfate could be substituted for nickel chloride in the above bath, tests were performed in which nickel sulfate was substituted for nickel chloride in equivalent amounts. Under conditions of plating set up by the author, a flaky non-adherent deposit was obtained. Even plating at lower current densities did not yield a satisfactory bright, hard deposit. Thus the chloride ion appears to be a necessary ingredient of this bath in order to obtain bright deposits at the high current densities which are used. Sulfate ion has a deleterious effect on the quality of the plate.

A further condition established in this work for obtaining deposits that are relatively inert to most chemical reagents is that the chromium-nickel content ratio must be kept at about 20 to 1.

Chromium-Nickel-Vanadium Electrolyte

In the past, many attempts have been made to electrodeposit vanadium metal. A report of numerous experiments was made in 1916 by Fischer[11]. In all of these experiments, no electroplate was obtained from aqueous solutions of vanadium salts. During the intervening years since 1916 no reports of any significance on the plating of vanadium have appeared in the literature until recently. Senderoff and Brenner[12] reported on attempts to deposit vanadium from aqueous solutions at high temperatures (570° F [300° C]) and at high pressures (2000–3000 psi). No vanadium plate was obtained, and only a black deposit of a complex nature was produced in some tests. If there was a deposit at all, adherence was poor in many cases.

In checking through a list of the metallic elements and their oxides, it is found that some of the metals have black oxides. A number of these metals can be electrodeposited, while others cannot, or at least have not been deposited hitherto out of aqueous solutions. Why some of these metals cannot be deposited has not been thoroughly explained as yet although various theories have been advanced from time to time. One line of approach is on an energy basis, wherein the heats of formation of the oxides and salts are considered. Such a line of approach was used by Fischer[11] in his study of the electrolysis of vanadium salts

If the heats of formation of the oxides and salts of certain of the metals are considered (Table I), it is realized that those metals which have low heats of formation of the oxides and salts generally have been plated with relative ease. The metals with high heats of formation of their oxides and salts are not deposited as a metal out of aqueous solutions.

It is known, for instance, that elements such as silver, copper, and nickel are very easily deposited from their salt solutions. The heats of formation of the oxides and salts of these elements are comparatively low; thus, the reducing power at the cathode is high enough to deposit the metal from the ionized salt. On the other hand, metals such as aluminum, titanium, and vanadium, the oxides and salts of which have high heats of formations, are not deposited from aqueous solutions.

Fischer[11] has discussed this question in some detail, especially as it applies to vanadium. According to him, it is possible that, since the oxides of vanadium have such high heats of formation, the reducing effect pro-

TABLE I. HEAT OF FORMATION OF METALLIC OXIDES AND SALTS[13]

Oxides	Calories	Chlorides	Calories	Sulfates*	Calories
Al_2O_3	399,050	$AlCl_3$	166,800	$Al_2(SO_4)_3$	714,460
V_2O_5	437,280	VCl_4	162,010	—	
V_2O_3	349,580	VCl_3	187,100	—	
TiO_2	217,400	$TiCl_4$	183,500	—	
Fe_2O_3	190,700	$FeCl_3$	96,300	$Fe_2(SO_4)_3$	641,700
CrO_3	136,000	$CrCl_3$	139,550	$Cr_2(SO_4)_3$	753,890
MnO_2	125,400	—			
MnO	90,800	$MnCl_2$	112,690	$MnSO_4$	247,070
SnO	69,770	$SnCl_2$	81,147	—	
NiO	57,830	$NiCl_2$	74,893	$NiSO_4$	227,050
CoO	57,490	$CoCl_2$	76,942	$CoSO_4$	225,090
CuO	34,890	$CuCl_2$	51,422	$CuSO_4$	178,700
Ag_2O	6,953	AgCl	30,590	Ag_2SO_4	166,100

*No data were found in the cited reference on the sulfates of vanadium, titanium and tin.

duced at the cathode by the electric current is insufficient to furnish the energy required to decompose a vanadic salt in aqueous solutions. In general, the energy required to decompose the salts is greater than that needed to decompose the oxides.

Thus, it was believed that if a vanadium salt was added to the bath containing nickel and chromium salts, a black deposit would result, especially since the vanadium would deposit out, not as metal, but most likely as an oxide. Under the conditions of electrodeposition this oxide would probably be the trioxide, since any pentavalent vanadium would be reduced to trivalent vanadium at the cathode.

A bath was made up containing chromic acid 26.8 oz/gal (200 g/l), nickel chloride 2.68 oz/gal (20 g/l), and vanadium 0.27 oz/gal (2 g/l), added as vanadium nitrate. Seven-tenths of a fluid ounce of glacial acetic acid was added per gallon of solution (6 ml per liter). Upon plating at a current density of 929 amp/ft² (100 amp/dm²), and at a temperature of approximately 86-95° F (30–35° C), a uniform, adherent deposit was obtained. The color was jet black. A steel rod that was black-plated in this bath was heated to redness (about 1380° F [750° C]) over a gas flame. The rod was quenched in cold water immediately. The only visible change was in the color, from a gray-black to blue-gray black; adherence was perfect. Another iron rod that was black-plated in the same bath was heated in hydrogen for ½ hour at 1380° F (750° C). As there was no visible change in the black deposit, the plated rod was further heated for ½ hour in hydrogen at 1830° F (1000° C). The deposit was not visibly affected by this high-temperature treatment. There was very good adherence; the deposit was jet-black in color. Attempts to identify, by X-ray diffraction methods, the various constituents of the coating were not successful, chiefly owing to interference by chromium. However, it is believed that deposits from this bath contain finely divided chromium and nickel metals, plus chromium oxide, and vanadium oxide, probably as trioxide. Spectrographic examination of the coating showed it to contain chromium, nickel, and vanadium. By microscopic examination all constituents of the deposit were found to be uniformly intermixed and to adhere very strongly to the base metal to produce a compact surface finish. A favorable composition of the electrolyte is 20 parts chromium to 4 parts nickel to 1 part vanadium. Larger quantities of vanadium increase the vanadium oxide content of the deposit.

Chromium-Vanadium Electrolyte

Since the addition of the vanadium salt to the bath containing chromic acid and nickel salts resulted in a solution from which black deposits could be electroplated, the next step in the work on black deposits was to omit the nickel salt from the bath. Thus, solutions were prepared which contained chromic acid and vanadium salts in a ratio of about 20 parts chromium to about 1 part vanadium. Additions were also made to each gallon of solution of 0.4–2.6 fluid ounces (3–20 ml per liter) of an organic acid such as formic, acetic or butyric. One solution that was used contained chromic acid 26.8 oz/gal (200 g/l), ammonium metavanadate 2.68 oz/gal (20 g/l), and acetic acid 0.18 fl oz/gal (6.5 ml/l). Electrodeposition was carried out at a current density of 929 amp/ft² (100 amp/dm²), and at a potential difference of about 12–15 volts. The temperature of the bath was maintained at 95–122° F (35–50° C). Very even, jet-black deposits were obtained.

Spectrographic analysis of the deposits produced from the above bath showed that they contained chromium and vanadium in about the proportions present in the plating solution. The deposits had more heat resistance than do the other deposits described, and maintained the black color under heat. The acid-resistance was about the same for all types of deposits. The deposits obtained with this bath were usually dull

black, but under varying conditions, such as a higher temperature and higher current density, enamel-like glossy black coatings were obtained.

Lead anodes were employed most of the time with the above plating solutions, although graphite anodes were used in a few instances. Cooling coils of stainless steel were initially used; however, when they corroded through, lead coils were substituted and gave good service.

Applications

The black finishes described above are useful in many applications; as far as is known, they are better than other types of black finishes for certain uses. One application that shows great promise is the coating of anode supports in rotating anode X-ray tubes, wherein good heat transfer is necessary in order to draw off the heat generated in the tube. Lack of proper heat removal sets a limit on the power input of such tubes. Heat transfer is greatly facilitated by the heat-absorbing properties of the black electrodeposit.

These black coatings can also be used on bimetal heat regulator elements, wherein the elements are subjected to a wide range of temperatures. A similar application is on various types of optical instruments.

Metals or conductors upon which electrodeposits usually can be applied are coated readily with these black finishes. Copper, nickel, brass, iron, 18–8 stainless steel, copper base alloys, and iron base alloys have been coated with black chromium-base electroplates. Aluminum has been plated with these coatings after it was first given one of the usual pretreatments. Tantalum and manganese did not take a deposit. Acceptable coatings have been applied on titanium, although not as readily as on metals such as copper.

While very large objects have not been plated in these black chromium baths, it does not appear that there should be any difficulty in doing so. However, the size of the object that can be plated may be limited by the power available, since very large power supplies would be required for large objects. Hollow articles or those having deep recesses are plated in the conventional manner, using conforming anodes.

Although these black finishes can be used for decorative purposes, their chief application will probably be where their chemical and physical properties, such as corrosion resistance and heat absorption, can be utilized.

Summary

A hard, bright chromium-base electrodeposit has been developed which can be applied at a high rate of deposition. The electrolyte contains chromic acid and nickel chloride plus a carboxylic acid. When this bright deposit is treated with hydrochloric acid for a few seconds, a black finish results. This finish is nonsmudging, very adherent, and uniform.

Another black, chromium-base electroplate has been developed which is deposited from an electrolyte containing chromic acid, nickel chloride, a vanadium salt, and a carboxylic acid.

A process has been developed for the electrodeposition of uniform, black electrodeposits from an electrolyte containing chromic acid, a vanadium salt, and a carboxylic acid. The coatings have good heat and chemical resistance.

Acknowledgment

The various plating solutions specified in this paper are covered by the author's patent applications, assigned to the Westinghouse Electric Corporation, now on file at the United States and Canadian Patent offices.

LITERATURE CITED

[1]W. R. Meyer, U. S. Pat. 2,364,993, December 12, 1944.
[2]W. R. Meyer and G. P. Vincent, Metal Finishing **45**, 61–63, 71 (1947).
[3]W. H. Price, Jr., Proc. Am. Electroplaters' Soc. **31**, 1943, 87–90.
[4]R. R. Tanner and H. J. Lodeesen, U. S. Pat. 1,911,726, May 30, 1933.
[5]H. J. Lodeesen, U. S. Pat. 2,272,216, February 10, 1942.
[6]Siemens and Halske, A.-G., Ger. Pat. 607,420, December 19, 1935.
[7]A. Ungelenk, J. Fischer, and H. Endrass, U. S. Pat. 1,975,239, October 2, 1934.
[8]Siemens and Halske, A.-G., Fr. Pat. 754,360, November 6, 1933.
[9]L. O. Gilbert and C. C. Buhman, U. S. Pat. 2,623,847, December 30, 1952.
[10]A. Brenner, P. Burkhead, and C. Jennings, J. Research, Natl. Bur. Standards **40**, 31–59 (1948) (Research Paper No. 1854).
[11]S. Fischer, Jr., Trans. Electrochem. Soc. **30**, 175–228 (1916).
[12]S. Senderoff and A. Brenner, J. Electrochem. Soc. **97**, 361–366 (1950).
[13]Handbook of Chemistry and Physics, C. D. Hodgman, ed. 33rd ed. Chemical Rubber Publishing Co., Cleveland (1951).

DISCUSSION

Dr. H. J. Wiesner (Bendix Products Division, Bendix Aviation Corporation, South Bend, Ind.): Dr. Quaely, I would like to ask two questions: First of all, what thicknesses of coatings were applied?

Mr. Quaely: Thicknesses as high as five mils were applied.

Dr. Wiesner: Do you have any data as to the relative salt spray resistance?

Mr. Quaely: We have made no salt spray tests.

Mr. Lloyd O. Gilbert (Rock Island Arsenal, Rock Island, Ill.): I would like to ask three questions: Do you have any data as to the per cent of efficiency of the bath that you are using?

Mr. Quaely: No, we have not. I imagine it would be of the same order as a conventional bright chromium bath, probably a little higher because of the higher operating temperature which tends to increase efficiency.

Mr. Gilbert: In the vanadium type of solution that you described, do you have any idea of the per cent of vanadium and chromium deposited?

Mr. Quaely: As far as we could learn through analysis, the amount of vanadium in the deposit fol-

lows fairly closely the amount in the original solution.

MR. GILBERT: One final question: The throwing power of the bath, has that been determined?

MR. QUAELY: No, it has not been determined, but conforming anodes were used for intricate parts. However, throwing power would probably approximate that of a conventional chromium plating bath.

MR. FRANK O. BEUCKMAN (Eastman Kodak Company, Rochester, N. Y.): Can these coatings be applied to the nickel-chromium type stainless steels?

MR. QUAELY: Yes, we have applied them directly to those metals.

MR. BEUCKMAN: Would these coatings be applicable to parts, for instance, like densitometers where a dead black coating is required?

MR. QUAELY: We have used them for that purpose in similar applications where we wanted a dense black coating.

MR. I. L. NEWELL (Henry Souther Engineering Company, Hartford, Conn.): What is the color that you obtained with the third bath?

MR. QUAELY: Black—in fact, I would say that it was blacker, if you can distinguish between black and blacker.

DR. FREDERIK S. SCHULTZ (General Electric Company, Cincinnati, Ohio): In the first bath that you have shown with nickel-chromium, did you notice any change in the composition with change in the base-metal—that is, the ratio of nickel to chromium?

MR. QUAELY: We have not checked into that, although we would not expect it to be any different so long as the composition of the bath did not vary too much.

MR. ISIDORE FRIEDMAN (Wright Aeronautical Corporation, Wood Ridge, N. J.): What do you mean by good protection at high temperatures—what is the temperature range required?

MR. QUAELY: On the order of 1000° C. Of course, in these cases, we do not expect the finish to remain black.

MR. FRIEDMAN: But it does give oxidation protection?

MR. QUAELY: Yes, it does.

MR. CHARLES GELDZAHLER (Platers Technical Service, Chicago, Ill.): Do thin coatings on the order of ten-millionths give dense black deposits?

MR. QUAELY: Yes, but in that case you won't have good oxidation protection; you have to go over to the heavier deposits to get protection.

MR. GELDZAHLER: Are these thin coatings abrasion resistant much on the order of bright chromium deposits?

MR. QUAELY: The silvery deposits are definitely more abrasion resistant than the black deposits, and probably approach the hardness values of regular chromium.

MR. GELDZAHLER: What happens after hydrochloric acid treatment—does it become loose?

MR. QUAELY: You cannot smudge off any of the coating.

MR. GELDZAHLER: In other words, it is abrasion resistant.

MR. QUAELY: Yes.

MR. A. E. DURKIN (General Electric Company, Lynn, Mass.): What high temperature life in hours does the coating have at 1000° C?

MR. QUAELY: We have not done much beyond 20 hours so far. We are aiming to run longer periods of time in future tests.

MR. W. B. STEPHENSON (General Electric Company, Evendale, Ohio): What effect does heat cycling have on the coating?

MR. QUAELY: Our limited tests have shown that the coatings will withstand heat cycling.

MR. STEPHENSON: What base metals have you tried?

MR. QUAELY: We have tried iron, copper, brass, stainless steel and various steel alloys.

MR. STEPHENSON: Do you get diffusion on all of those base metals?

MR. QUAELY: On all of those we have had diffusion, and the amount of diffusion varied with time and temperature.

MR. PHILLIP H. EISENBERG (Sylvania Electric Products, Bayside, L. I., N. Y.): What effects, if any, do the various thicknesses have on this deposit, particularly the smoothness, ductility and structure?

MR. QUAELY: If the rate of deposition is not too high, you can obtain smooth coatings in the range of 5 mils. These coatings tend to become rough if you try to obtain thick deposits at too high a rate.

DR. WIESNER: I just wanted to get one point straight in my mind—the question was asked as to whether you apply this coating directly to stainless steel. You said "yes", and I wanted to make sure that there was no activation process in between.

MR. QUAELY: Yes, no type of electrochemical treatment was used other than cleaning of the surface to remove any dirt.

DR. WIESNER: Is that 18–8 type of stainless?

MR. QUAELY: Yes.

MR. HANS C. SCHLAUPITZ (R. Wallace & Sons Mfg. Co., Wallingford, Conn.): Does prolonged heating at elevated temperature reduce the hardnesses of deposit?

MR. QUAELY: Since diffusion will take place to some extent, the hardness will be affected and it will depend upon the hardness of the base metal plus the hardness of the alloy that is formed in the diffusion process; it will not have the original hardness of the coating.

MR. SCHLAUPITZ: Other than diffusion, would you expect any softening?

MR. QUAELY: I would expect some softening.

CRACK-FREE CHROMIUM FROM BATHS OF THE SELF-REGULATING HIGH-SPEED TYPE*

R. DOW† AND J. E. STARECK†

Introduction

Since its development as a commercially feasible process nearly thirty years ago, chromium plating has maintained a dominant position in the electroplating industry. This has been due to the unique properties of the deposit itself. Unlike other metals, chromium can be deposited bright without the use of addition agents, it is extremely hard, and it is very resistant to corrosion. In decorative plating, the fact that it can be deposited bright is one of its assets, and has made possible the production of a vast amount of work which retains not only its brightness, but also its color under a variety of conditions. In the field of hard plating, perhaps the property of chromium most considered is hardness. Here, the usual type of protection afforded is that against mechanical wear. However, while brightness and hardness are factors in the respective fields, the subject of corrosion protection is common to both. These so-called different types of chromium are, at times, subjected to corrosive atmospheres, regardless of whatever the primary function of the plate might be. In many instances, the corrosion resistance of the chromium itself is able to furnish sufficient protection. However, there are other instances where corrosion of the underlying metal takes place, and herein, lies a limitation of ordinary chromium deposits.

As normally deposited, chromium, at the decorative thicknesses, contains a series of pores, varying in number with the plating conditions. As the thickness of the plate increases, the number of pores decrease, but there develops a pitted or cracked structure which continues, regardless of how much the thickness is increased. These are the various imperfections that are responsible for the lack of complete protection of the underlying metal. In a corrosive atmosphere, the corrosive medium filters through these discontinuities in the plate and attacks the underlying surface. Thus, while the chromium itself is able to resist corrosion, the presence of cracks or pores renders the deposit less than completely corrosion protective.

There are, on the other hand, instances where the cracked structure of the chromium is of value. One of these is in the field of porous chromium plating where conditions of deposition are so chosen that a crack-structure is produced and developed to the extent that it can be used as a reservoir for oil in bearing surfaces. However, porous chromium plating is a specialized application, whereas the general requirement of chromium is that it be as crack-free or pore-free as possible.

The problem of producing an impervious electroplate has long been recognized as well as one answer to the problem; that is, to find a chromium deposit that would be free of any imperfection that would allow corrosive materials to come in contact with the less corrosion resistant underlying surface. Such a deposit has now been discovered, and can be reliably produced from special baths of the chromic acid type by particular co-ordination of bath composition and plating conditions. The process is altogether practical, readily controllable, and operates at usual current densities and current efficiencies.

General Discussion

To date, this investigation has been limited to the development of crack-free chromium from self-regulating type solutions[1], and to comparative tests between it and the ordinary chromium plate now in general use. The solutions were studied over a chromic acid concentration range extending from 200 to 900 g/l CrO_3. Crack-free plates were obtained over this range, depending on the type and concentration of catalyst used. Most of the work, so far, has concerned itself with solution temperatures of 140° F and above. Much below this temperature, the deposit tended to have cracks or pores, be nodular, or have other technical disadvantages.

Of further interest is the fact that crack-free deposits were produced that had differences in other physical characteristics. As yet, these differences have not been assessed completely. However, their presence suggests

*Presented at the Fortieth Annual Convention of the American Electroplaters' Society, June 16, 1953.
†United Chromium, Inc. Detroit, Michigan.

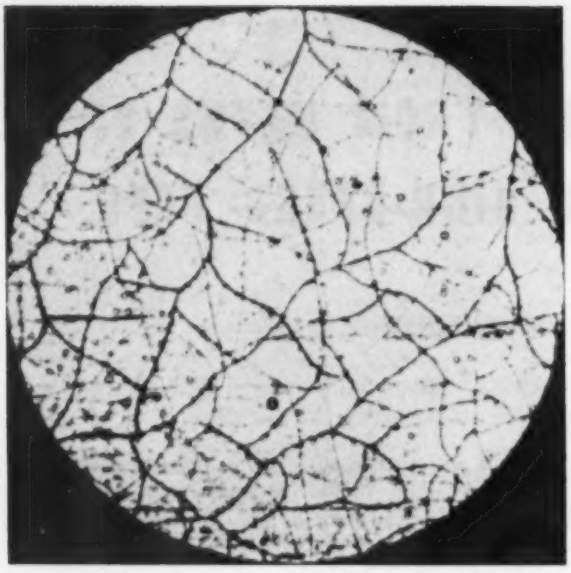


Fig. 1. Cracked chromium, surface view

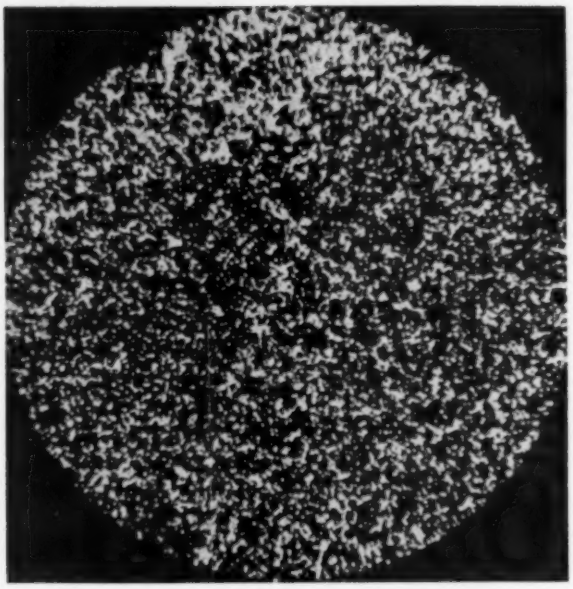


Fig. 3. Pitted chromium, surface view

the value of this method of obtaining deposits having particular characteristics with respect to such properties as hardness, leveling action, internal stress, and color.

In assessing the worth of the crack-free plate, it may best be done by discussing the various tests that were performed with the plate, and the results of those tests. Some phases of this investigation had a comprehensive study, while others were of necessity, relatively preliminary. However, regardless of the scope of the tests, the results showed certain advantages to be gained from the crack-free plate.

Structure of Deposit

In the preliminary investigation, a comparison was made of the type of pattern developed upon etching deposits obtained from the various types of chromium plating solutions now in production use. The pattern may be a cracked structure, as shown in Fig. 1. Here, the design somewhat resembles a mud flat in that there are cracks surrounding relatively large areas unaffected by the etching. Fig. 2 is a cross section of the same type of plate. The cracks noted in Fig. 1 extend a considerable distance into the deposit, and are widely spaced. The pattern may also be a pitted structure, as shown in Fig. 3 which is a top view of this type of plate. Here, instead of the cracked structure, the surface is full of pits. In cross section, Fig. 4 shows the surface to have pits or indentations. While they are not generally as deep as the cracks, they are more

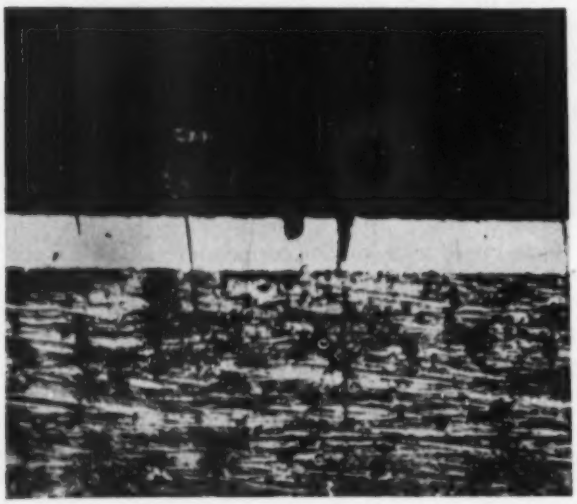


Fig. 2. Cracked chromium, cross-sectional view

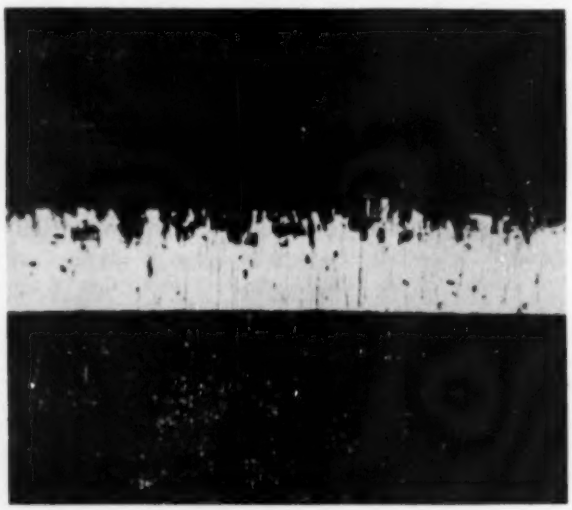


Fig. 4. Pitted chromium, cross-sectional view

numerous. Etching the surface, of course, does not produce these different types of patterns; rather, it develops the pattern that is inherent in the deposit. Thus, though in some instances these pits or cracks may not extend to the base metal, they are points of weakness through which corrosion may eventually occur.

In contrast to these two types of structure which are characteristic of ordinary chromium, crack-free plate, when etched in a similar manner, proved to be free of such imperfections. Fig. 5, which is a top view, presents the surface as being microscopically irregular, due to its being deposited dull. A cross section of the crack-free plate, Fig. 6, shows that instead of the gross indentations, cracks, or other cross-sectional porosity, the plate has a dense, continuous structure. This is one manifestation of crack-free plate. This deposit, free of gross imperfections, should be able to perform the functions of a crack-free plate. Since these early tests, the range of conditions over which crack-free deposits have been obtained has been extended.

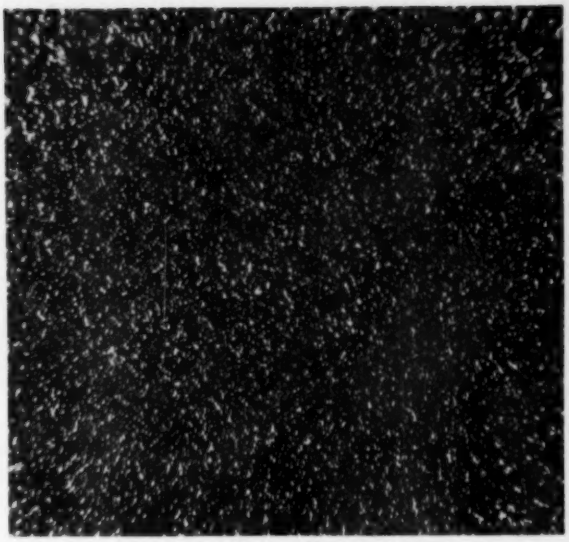


Fig. 5. Crack-free chromium, surface view

Resistance to Thermal Stress

Following investigation into the absence of cracking of the plate at room temperature, the crack-free chromium was heated to a temperature of 1000° F for one hour. Examination of the deposit after this heat-treatment showed no cracks. On the other hand, when chromium that had a pitted structure was heated, cracking was observed at approximately 300° F. This cracking became more pronounced as the temperature was increased. Chromium deposits having a cracked structure at room temperature reacted in a similar manner to heating, that is, raising the heat-treating temperature caused an increase in the number of cracks. This test will be recognized as having value in those instances where corrosion protection is required at high temperature.

Corrosion Data

One of the advantages of the crack-free plate is, of course, that it offers good corrosion protection to the underlying electrodeposits and base metals. Without this inherent feature, the deposit is unable to justify the claim that it is crack-free. In the investigation into the corrosion protection afforded by the crack-free plate, initial tests were concerned with the effect of salt spray exposure on the chromium directly over steel, without any intermediate deposit. Comparison was made between the crack-free plate and that plated in the ordinary type solutions. After being plated, the panels were placed in a 20 per cent salt spray test cabinet at 95° F. The results of this test are shown in Fig. 7. After 24 hours, the ordinary chromium plated panel failed so badly that it was removed from further test. This, incidentally, was true of chromium deposited from all types of chromium plating solutions now in general commercial use. Over the same test period, the crack-free deposit showed no rusting whatsoever. The test on the crack-free plate was continued to 100 hours, at which time the panel showed a few scattered pin-point rust spots. The run was finally concluded after 175 hours' exposure. Even after this prolonged period, which was seven times that required for the ordinary chromium coated specimens to fail completely, the crack-free plated panel still showed only approximately 15 per cent failure.

In addition to the salt spray tests, outdoor exposure tests were run, once again to compare the crack-free and ordinary deposits. As in the previous tests, mild steel panels were plated in both types of solutions. In this instance, however, two different thicknesses of plate (0.0002 inch and 0.0005 inch) were studied. In addition to the sets that were prepared for studying the crack-free plate in the as-plated con-

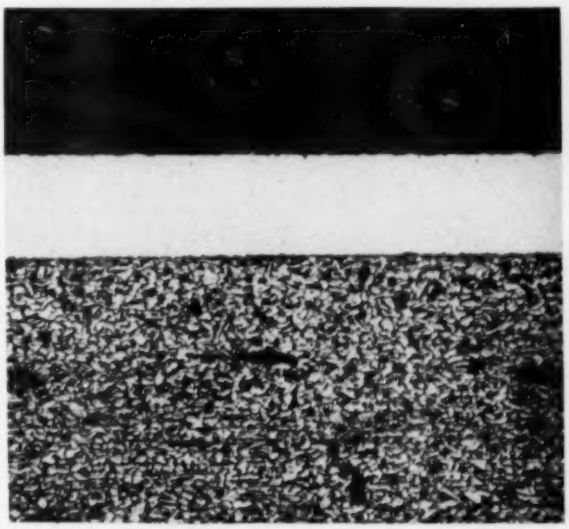
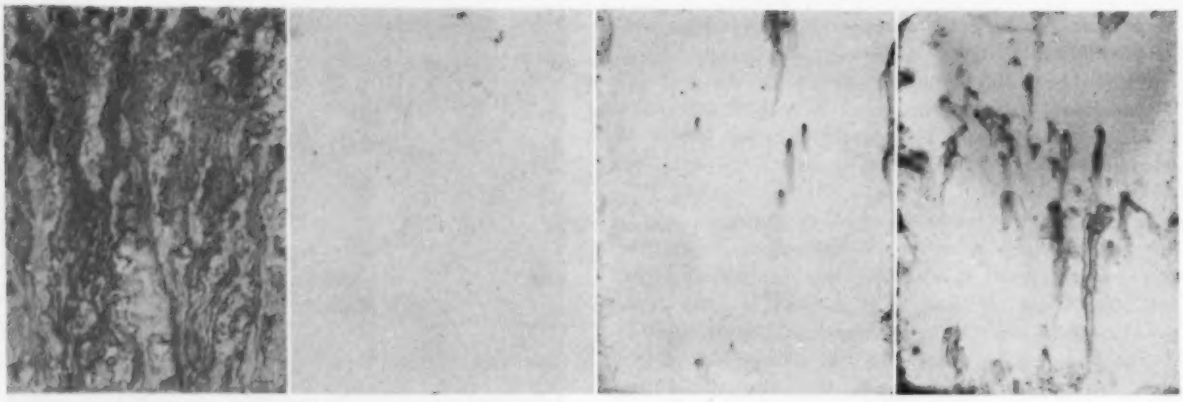


Fig. 6. Crack-free chromium, cross-sectional view

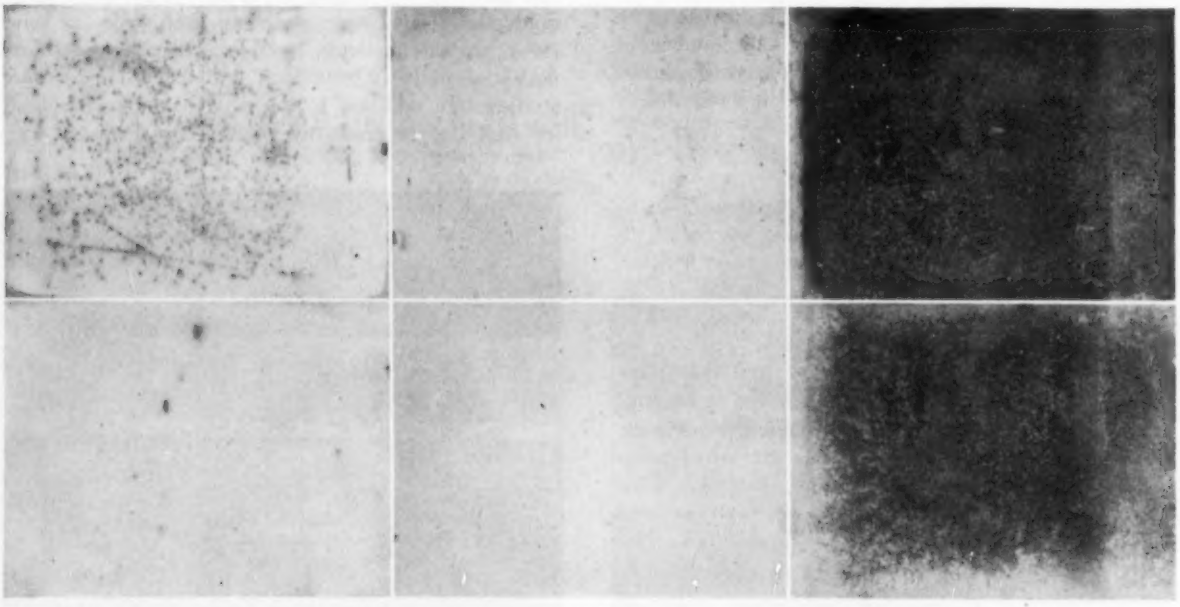


a b c d

Fig. 7. Salt-spray test results, chromium, 0.0003 inch thick, directly on steel. (a) Ordinary, and (b) crack-free, both after 24 hours' exposure; (c) crack-free after 100 hours' exposure; (d) crack-free after 175 hours' exposure

dition, other sets were plated in the crack-free solution to the same thicknesses. The second sets of panels were then buffed to a bright finish. This was done as a check on the possibility of using the plate as a decorative deposit. After being plated, the panels were placed on the roof of the Detroit laboratories of the authors' company at the beginning of January, 1952, and left there through the following May. During this period, they were subjected to snow, rain, and the quick temperature changes of spring. This coupled with the fact that the laboratories are located in what might be termed a moderate manufacturing area, produced a reasonably corrosive set of conditions. The results of these outdoor exposure tests are shown in Fig. 8.

First, considering the 0.0002 inch deposits, it is evident that the crack-free plate in the as-plated condition has failed to the extent of approximately 25 per cent. Buffing the deposit seems to improve the corrosion protection of the chromium since the pin-point rusting is shown to be limited to a few scattered rust spots. In contrast to these relatively good results, the



a b c

Fig. 8. Results of 5 months' outdoor exposure test of chromium deposited directly on steel. Top row, (a) 0.0002 inch crack-free chromium; (b) 0.0002 inch crack-free chromium, buffed after plating; (c) 0.0002 inch ordinary chromium. Bottom row, (a) 0.0005 inch crack-free chromium; (b) 0.0005 inch crack-free chromium, buffed after plating; (c) 0.0005 inch ordinary chromium.

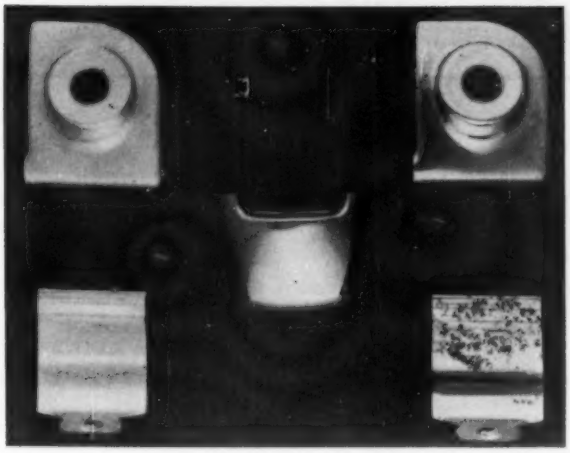


Fig. 9. Parts with crack-free chromium, as-plated and buffed

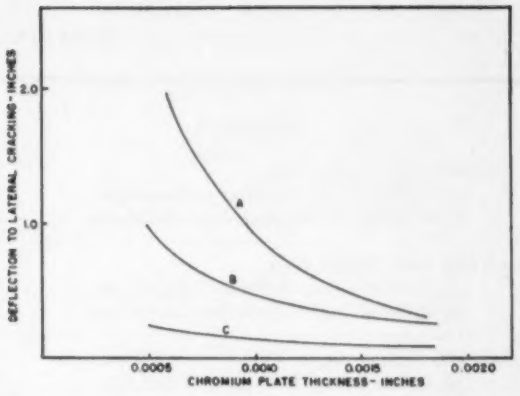


Fig. 10. Results of internal stress measurements

ordinary plate, in the same period, is seen to have failed completely.

Now, considering the 0.0005 inch deposits, a general improvement is noted, although the same trend exists. The crack-free plated sample in the as-plated condition has only approximately eight rust spots, while the buffed crack-free deposit shows less corrosion (only one or two spots). The ordinary chromium which was used as the standard of comparison for the same period of test and the same thickness shows approximately 75 per cent failure.

The effect of the crack-free chromium was next studied in conjunction with intermediate deposits. While this work was quite extensive, the following are some of the more important comparisons that were made.

As in the tests on chromium directly over steel, this phase also was concerned with a comparison of the corrosion protection afforded by the ordinary and crack-free plates under the conditions of the salt spray and outdoor exposure tests. In all these tests, the mild steel panels were first plated with copper or nickel or both, prior to chromium plating. In one series, the undercoating was 0.001 inch of copper, in another, 0.001 inch of nickel, and in the third, 0.0005 inch of copper and 0.0005 inch of nickel. Chromium was then deposited from both types of solutions to a thickness of 0.00005 inch. One set of each series was placed on the roof of the Detroit laboratories as before, and the other set in the salt spray test under the previously noted conditions. The results of these tests are summarized in Tables I and II.

Table I is a comparison of the two types of chromium over various undercoatings when subjected to a salt spray test. The duration of this test was 220 hours. Over the 0.001 inch of copper, the ordinary deposit showed approximately 60 rust spots. Over the same amount of copper, the crack-free plated test pieces had an average of one pin-point rust spot per panel. On 0.001 inch of nickel, the ordinary plate had an average of 8 rust spots per panel, while the crack-free plate had one rust spot per panel. Over the composite copper-nickel coating, the ordinary deposit had, on the average, 12 times as many rust spots as the crack-free plate. It is interesting to note that the amount of corrosion was the same on each crack-free panel, regardless of the intermediate coating, indicating that the corrosion protection afforded by the crack-free plate was, in some way, independent of the coating between it and the base metal.

Table II shows that the results of the 18 months' outdoor exposure tests of chromium on intermediate coatings are in line with the rest of the tests. In each instance, the crack-free deposit shows consistently less rusting than the ordinary plate. Here, too, it was

TABLE I. SALT SPRAY TEST RESULTS OF CHROMIUM ON INTERMEDIATE COATINGS OVER STEEL*

Deposit	Rust Spots
0.001 inch Copper plus	
(a) 0.00005 inch, Ordinary chromium	60
(b) 0.00005 inch, Crack-free chromium	1
0.001 inch Nickel plus	
(a) 0.00005 inch, Ordinary chromium	8
(b) 0.00005 inch, Crack-free chromium	1
0.0005 inch Copper, 0.0005 inch Nickel plus	
(a) 0.00005 inch, Ordinary chromium	12
(b) 0.00005 inch, Crack-free chromium	1

*Duration of test—220 hours.

TABLE II. OUTDOOR EXPOSURE TEST RESULTS OF CHROMIUM ON INTERMEDIATE COATINGS OVER STEEL*

Deposit	Remarks
0.001 inch Copper plus	
(a) 0.00005 inch Ordinary chromium	100 per cent rust
(b) 0.00005 inch Crack-free chromium	Intermediate amount of pin point rusting
0.001 inch Nickel plus	
(a) 0.00005 inch Ordinary chromium	Crazing plus intermediate amount of pin point rusting
(b) 0.00005 inch Crack-free chromium	Intermediate amount of pin point rusting
0.0005 inch Copper, 0.0005 inch Nickel plus	
(a) 0.00005 inch Ordinary chromium	Excessive pin point rusting
(b) 0.00005 inch Crack-free chromium	Intermediate amount of pin point rusting

*Duration of test—18 months

noted that the corrosion on each of the crack-free panels was the same, further strengthening the idea that the crack-free plate has a corrosion protective effect independent of the intermediate coating. While not noted in this table, it should be mentioned that a crack pattern was observed in some of the ordinary plates. At the conclusion of the outdoor exposure test, fine lines of corrosion were visible at these cracks. No such condition was present on the crack-free plates.

Co-incidental with these tests, others were run, comparing the two types of chromium at lower thicknesses, 0.00001 and 0.00002 inch, which are in the decorative range. Here, the corrosion trends were the same as those established for the thicker deposits. The crack pattern that was visible in the thicker ordinary plate was not evident at 0.00001 or 0.00002 inch. Apparently, this type of plate has to be between 0.00002 and 0.00005 inch thick before the internal stresses build up to such a point as to require relief through cracking.

Thus, the results of the tests of chromium over intermediate coatings agreed with the previous data on chromium directly over steel, showing the superiority of the crack-free plate over ordinary chromium.

TABLE III. HARDNESS MEASUREMENTS*

Deposit	Diamond Pyramid Hardness
Ordinary chromium	750– 900
Self-regulating catalyst chromium	850–1025
Crack-free chromium	425– 700

*Instrument—Tukon Hardness Tester
Indentation—136° diamond pyramid
Load—500 grams

Hardness

Hardness measurements were run on the crack-free chromium, and, the results pointed up one of the differences that occurred when the deposition conditions were changed. In making these measurements the values of which are contained in Table III, a Tukon hardness tester, with the 136° diamond pyramid under a 500-gram load was used. The ordinary chromium varied between diamond pyramid hardness numbers of 750 to 900 and the plate from the self-regulating type solution varied between 850 and 1025. The hardness range of the crack-free plate was much lower, varying from 425 to 700, depending on the soltuion from which it was plated. Crack-free plates were produced with higher hardness values, but they appeared to be on the border between crack-free and ordinary deposits, and cannot be classed as crack-free in the strictest sense of the word.

Buffing Characteristics

One advantage of having these deposits softer than normal is that they can be buffed without too much trouble. As plated, the crack-free deposits are dull or, at best, semi-bright. By having them only moderately hard, they can be buffed to a high luster as shown in Fig. 9. On the left, are parts plated with crack-free chromium. The others are similar parts plated under identical conditions. The only difference is that these were buffed after plating. Thus, it is evident that although the plate was deposited dull, it could be brought to a high degree of brightness. Also, referring back to the work on the corrosion resistance of the deposit, it is logical to expect that the buffed part would have better corrosion resistance than the unbuffed one.

TABLE IV. SURFACE LEVELING DATA*

Deposit	Surface roughness—RMS		
	Before plating	After plating	Per cent decrease
0.0025 inch			
Ordinary chromium	43	43	0
Crack-free chromium	39	36	7.7
0.0050 inch			
Ordinary chromium	45	43	4.5
Crack-free chromium	43	34	21.0

*Instrument—Brush Surface Analyzer

Leveling Action

Very often, the smoothness of the deposit is associated with the brightness, and in considering the smoothness of the plate, the question of the leveling action of the crack-free plate arises. Here, too, test results indicated a definite advantage in favor of the crack-free plate over the ordinary chromium plate. Mild steel panels were first ground, using a 180 grit wheel. They were then plated in the crack-free and ordinary solutions to thicknesses of 0.0025 inch and 0.0050 inch. Surface measurements were taken with the Brush Surface Analyzer, before and after the panels were plated. The results of these measurements are contained in Table IV. At a thickness of 0.0025 inch, the crack-free plate reduced the surface roughness from an rms value of 39 to 36, or a relative decrease of 7.7. per cent. At the same thickness, the ordinary chromium did not show any reduction in surface roughness. Increasing the thickness of the plate to 0.0050 inch caused the crack-free plate to reduce the roughness from an rms value of 43 to 34, or a relative decrease of 21 per cent. At 0.0050 inch in the ordinary chromium, there was a decrease in the surface roughness from an rms value of 45 to 43, or a relative reduction of only 4.5 per cent. Thus, it seems on the basis of the results obtained to date, that the crack-free deposit has leveling action superior to that of the ordinary plate.

Plating Speed

One very important characteristic of any plating solution is the rate at which the metal can be deposited. In the crack-free solutions, the plating rate at 3 amps/sq in, which is the normal operating current density, varied from 0.00065 to 0.00150 inch per hour at 150° F. In the preliminary work, lower temperatures were used; however, as the investigation progressed, it became apparent that the operating ranges were wider as the temperature was increased, and, thus, 150° F was decided upon as a practical value. As in the case of the hardness of the deposits, variations were noted in the current efficiencies from one type of crack-free solution to another. A general inter-relationship was also noted between the variations in the hardness of the plate and the current efficiency range of the solution. As the current efficiency range increased from one solution to another, there was a similar increase in the hardness of the deposit. Since this relationship was found to exist, it may be indicative of a more fundamental difference in the composition of the deposit. When time permits, this particular point will be investigated further.

Effect of Tensile Loading

The most recent study of the crack-free plate covered the internal stress of the deposit, or its ability to withstand externally applied stress. The effect of thermal stress has already been discussed above, but in this instance, consideration was given to the effect of a tensile load applied to the deposit and the subsequent effect on the part on which the chromium is plated. This phase of chromium plating research has been a source of continued interest for workers in the electroplating industry, but it has become more important because of the wider application of chromium plate. With the advent of World War II, industry, in general, found that chromium could be used for a variety of purposes that had not been considered previously. However, in certain instances, it was noted that when a load was applied to the part in sufficient amount to deflect it, the plate, if not already cracked, would do so, thereby opening up points where corrosion of the underlying metal could take place. Deposits that were produced in the cracked condition were, of course, unsuitable even before being subjected to tensile loading, while others that cracked under a similar type stress were a doubtful improvement. This, then, has been a serious limitation of chromium plate. Crack-free plate, however, shows promise of overcoming this defect since the tests, so far, indicate that this type of plate can stand higher externally applied stresses than the ordinary chromium

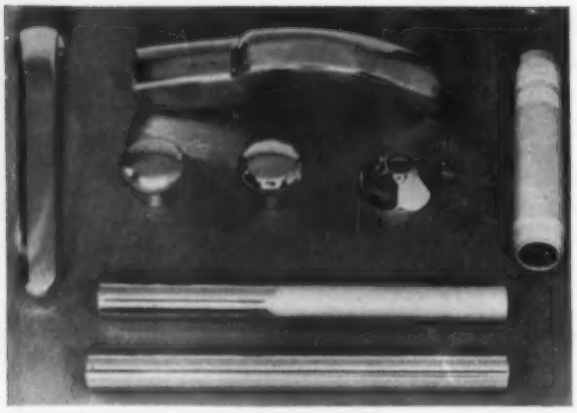


Fig. 11. Assorted parts plated with crack-free chromium

deposit that has not cracked or had other types of stress relief.

In comparing the various types of deposits, mild steel strips were first plated in three types of chromium plating solutions. The first was an ordinary type of chromium that had cracks in the deposit, the second was an ordinary chromium of the pitted type. The third was crack-free chromium. The thickness of plate was varied between the approximate limits of 0.0005 inch and 0.002 inch. The strips were then placed in a fixture resembling a vise. A force was applied to the ends of the strip, causing it to bow in the middle. The force was then increased until the strip was deflected sufficiently to cause lateral cracks in the deposit. The amount of deflection was taken as a measure of the force required to crack the deposit. The performance of the three general types of chromium are plotted in Fig. 10. *A* is the curve of the cracked ordinary chromium. Here, a certain portion of the stress was taken up by the cracks in the plate which resulted in opening them up wider than in the as-plated condition. In the thinner deposits, the net internal stress of the chromium was low enough that the plate could withstand considerable deflection before lateral cracking occurred. However, as the thickness increased, the inherent cracks were not able to provide a corresponding increase in relief and lateral cracking required less deflection. In fact, it would appear that if the thickness were increased sufficiently, there would be a co-incidence or intersection between this curve and that of the crack-free plate, *B*. In the crack-free plate, there was no crack pattern to absorb the external stress, and thus, all the stress was on the deposit. In the thinner deposits, the amount of deflection required to crack the plate was less than that required for ordinary chromium, but as stated, the difference in performance of the two types of deposits decreased with increasing thickness and indicated reaching a point where the crack-free plate is superior to the ordinary chromium in this respect. It is important to realize that up to the point at which lateral cracking occurred, there was no decrease in the corrosion protective value of the crack-free plate, as contrasted to the ordinary plate in which the widening cracks decreased the corrosion protection afforded by the deposit. The pitted plate, curve *C*, requires little comment except that the amount of deflection required to crack the plate is quite low. In fact, at the point where the curves seem to be leveling out, the deflection necessary to crack the pitted plate is one-third that required for the crack-free plate. This is considered to be a more important comparison than any involving curve *A*, since the deposit it represents was cracked in the as-plated condition. Attempts are being made to similarly compare the crack-free plate and a plate such as that represented by curve *C* after they have been subjected to a heat treating operation. Unfortunately, since the ordinary deposit cracks on heating, this distinction has not yet been possible because of the difference in the reaction of the two types of chromium to heating.

Fatigue Testing

Another phase of this problem is the effect of fatigue stresses on the chromium deposit and the total effect on the metal on which it is plated. This is slightly different from the previous problem in that the load is continued and increased under the conditions of the fatigue testing machine until the part ruptures. The authors' company has been engaged in studying this phase of the effect of externally applied stresses for nearly a year, and just recently, this work has been extended to the effect of the crack-free plate in this respect. Results, to date, are too limited for discussion; however, sufficient data should soon be available to determine the performance of the crack-free plate under a fatigue-type load.

Pilot Plant Performance

In addition to the laboratory work described above, pilot plant tests are now being run on a 70 gallon tank of the crack-free chromium solution. This part of the investigation is still in the preliminary stage, but it is expected that these results will duplicate those obtained in the laboratory, showing that the crack-free chromium does have properties that are advantageous when compared to the ordinary type of plate. In particular, this phase of the investigation is concerned with the application of crack-free chromium to production items. Fig. 11 shows parts typical of those being plated, and an insight into the wide variety of application. Included, are bright, scratch-brushed, and dull surface finishes of crack-free chromium over such base metals as steel, copper, brass, and nickel-plated zinc-base die castings.

Conclusions

Thus, the crack-free chromium shows promise of having a wide variety of applications. The fact that it is crack-free, of course, suggests many uses where

improved corrosion protection over that presently obtainable is desired. In the field of decorative plating, this means the promise of bright coatings requiring less, or possibly no, intermediate plate, an important consideration in these times of strategic metal shortages. In hard plating, the crack-free plate also means the use of chromium in applications where the present conditions of mechanical or thermal stress restrict the use of deposits of that metal. While the immediate appeal, perhaps, is more to the specialized application, crack-free chromium should occupy, in the future, an important place in the electroplating industry as a general purpose deposit.

REFERENCE CITED

J. E. Stareck, F. Passal and H. Mahlstedt, "Self-Regulating High-Speed Chromium Plating", Proc. Am. Electroplaters' Soc. 37: 31–49 (1950).

DISCUSSION

MR. JOHN LILIENSTERN (Monarch Machine Tool Company, Sidney, Ohio): What is the equivalent composition of the crack-free chromium plating bath?

MR. DOW: The process is the subject of a pending patent application, and, thus, the composition of the bath cannot be disclosed at this time.

DR. WIESNER (Bendix Products Division, Bendix Aviation Corp., South Bend, Ind.): First, I would like to compliment the authors on a very excellent and complete paper. My question is this: are there any special procedures required in plating this chromium in relation to cleaning and etching as contrasted to ordinary chromium plating?

MR. DOW: The plating conditions and equipment are exactly the same as that required for the ordinary type chromium plating solution.

MR. L. M. MORSE (Chrysler Corporation, Detroit, Mich.): I would like to ask if you recommend plating the conventional chromium to a thickness of 0.00005 inch on nickel?

MR. DOW: No, this was a comparative test at that particular thickness. We did run tests at 0.00001 inch and 0.00002 inch and obtained the same trend as that noted at the thicker deposit.

MR. MORSE: It just occurred to me that using 0.00005 inch thickness is an unfair comparison because nobody uses that in conventional chromium plating.

MR. DOW: That is true, but as I pointed out, we tested deposits at 0.00001 inch and 0.00002 inch which are in the decorative range, and we noted exactly the same trend as at the thicker deposits.

DR. WILLIAM BLUM (Washington, D. C.): I would like to ask the authors what are the differences between their deposit and that reported in the work that was described and published by the Bureau of Standards on the so-called "low contraction" chromium. In the Bureau's report it was shown that when high temperatures and appropriate current densities were used during deposition, chromium that was relatively free from cracks and did not crack on heating was obtained; and the chromium was nearly pure with respect to the presence of oxide. Is it safe to assume that the chromium the authors describe is similar to that?

MR. DOW: I would say that it is of the same general type. Unfortunately, we have not yet made comparisons between the various types of crack-free deposits so that no definite statement can be made, but I would say that it is a fair assumption.

MR. HANS C. SCHLAUPITZ: Were any internal stress measurements made on the crack-free deposits?

MR. DOW: I presume you mean, using the Brenner-Senderoff contractometer.

MR. SCHLAUPITZ: Yes, measurements of that nature.

MR DOW: We ran bend tests in which the plated strip was deflected until lateral cracking of the deposit occurred. We considered this to be a measure of the internal stress.

MR. SCHLAUPITZ: I am thinking with regard to electroforming type of applications where dimension control may be very important and where you would want as low an internal stress as possible.

MR. DOW: This deposit, when compared to an ordinary chromium that had no type of stress relief, has approximately one-third the internal stress of the ordinary deposit.

MR. MORTON SCHWARTZ (Surface Alloys, Los Angeles, Calif.): You gave a range of hardness, from 475 to 700, which is very close to the lower range of the ordinary hard chromium. What I would like to ask is this: Was the hardness determined for each specimen to see if there was a correlation between the hardness of that specimen and the load required for cracking?

MR. DOW: We ran stress tests over the entire hardness range and obtained similar results at all hardness values.

MR. SCHWARTZ: Also, I would like to ask whether the hardness of the deposit from this particular bath varied with current density. Did you say that you used a current density of 3 amps per square inch exclusively?

MR. DOW: We have plated and obtained crack-free deposits at other current densities, but we have not, as yet, studied the effect of current density on hardness. We have found, however, that increasing the temperature of the plating solution decreases the hardness of the deposit slightly.

MR. JACK H. CHARLES (Empire Electroplating Works, Ltd., Montreal, P. Q., Canada): How long does it take to deposit crack-free chromium as compared to ordinary chromium?

MR. DOW: On the average, the plating rate in both types of solutions is about the same.

MR. CHARLES: Is it applicable to job shop plating?

MR. DOW: With respect to job shop plating, inasmuch as the same conditions and equipment as that presently used is required, the answer is yes. How-

ever, I do not feel that the process has been developed to the point that it is ready for general job shop plating.

MR. CHARLES: How sensitive is it to impurities?

MR. DOW: We have not found any impurities that have a deleterious effect outside of those which are harmful in the ordinary type of chromium solution.

MR. A. KORBELAK (PLATING, Newark, N. J.): Was any work done to test the high temperature (1000° C and up) protective properties of the crack-free chromium?

MR. DOW: The highest we have gone is 1000° F, but we have not observed any cracking at this temperature. We, of course, expect to project our tests into the higher temperatures as time progresses.

• • •

Australian Electroplaters' Convention

The First Australian Federal Convention on Electroplating was held at the Hotel Federal, Melbourne, from May 18–20. Delegates from New South Wales, South Australia, Western Australia and Tasmania were among the 160 who attended. The Convention was organized by the Melbourne Branch of the American Electroplaters' Society, and supported by the Sydney and Adelaide Branches.

The highlights of the Technical Sessions were the talks by Dr. William Blum of U. S. A., the world-famous authority on electroplating who was invited to Australia especially for this Convention. During his three months in this country, Dr. Blum visited Melbourne, Hobart, Launceston, Adelaide, Sydney and Brisbane, lecturing not only to A. E. S. branches, but to chemical and metallurgical societies and university groups.

Other features of the Convention included a competition for the best plating exhibit board, which attracted entries of a very high standard. Delegates were also enthusiastic about the visits of inspection to Trans Australia Airlines, Essendon, and General Motors-Holdens Ltd., Fishermen's Bend. The programme was most effectively concluded on the third night with a dinner-dance in the Regent Room of the Hotel Federal where a very happy gathering of 175 made the hotel literally ring with their celebrations. At this function Dr. and Mrs. Blum were presented with a silver salver engraved with the Australian coat of arms and suitably inscribed as a memento of their Australian tour.

The Convention has been voted an outstanding event in the history and progress of electroplating in Australia. The Melbourne Branch of the American Electroplaters' Society is publishing a volume of "Proceedings" containing the Papers presented at the Technical Sessions and the discussion on them. These will be available at ten shillings per copy on application to the Secretary, A.E.S. Melbourne Branch, G. P. O., Box 4591, Melbourne, Victoria, Australia.

Toast to H. M. Queen Elizabeth II at Dinner-Dance, Hotel Federal. Dr. and Mrs. Blum at official table

Delegates Enjoying Refreshments Between Sessions

Chemicals you live by

YOU GET *UNIFORM QUALITY* WITH DIAMOND CHROMIC ACID

Don't you have enough headaches that throw off the quality of your plated ware?

You don't need to suffer from variations in your chromic acid—that's one headache you can get rid of. DIAMOND controls more steps in the production of its chromic acid than any other producer. It controls more of the ingredients than any other producer.

DIAMOND's new Technical Center is ready to give you the most up-to-date service with technical problems.

This extra service—extra assurance of quality, controlled at *every* step by the one manufacturer—costs you *nothing extra*. Just make your calls to the DIAMOND sales office, or write direct to Cleveland.

DIAMOND CHROMIC ACID

DIAMOND ALKALI COMPANY...CLEVELAND 14, OHIO

DIAMOND ALKALI CHEMICALS

LET'S LOOK AT BOTH

TAILS ➧

PRICE

"There is hardly anything
in the world that some man
cannot make a little worse
and sell a little cheaper,
and the people
who consider price only
are this man's lawful prey."

Ruskin

INDICATE A 1035.

SIDES OF THE COIN

HEADS

W. GREEN ELECTRIC COMPANY, INC.

SELECTRO PLATERS AND ALL TYPES OF RECTIFIER EQUIPMENT

GREEN EXCHANGE BUILDING 100 CEDAR STREET NEW YORK 6, N. Y.

RECTIFIER ENGINEERS

I'll tell you why . . . because they're designed to take all the punishment of mass-production plating—and last far longer. Hanger assembly is built extra rigid to reduce maintenance. It slips right into those new-type saddle brackets on the tank for extra strong support plus greater ease in handling. That's a typical H-VW-M performance-proved feature.

And no matter what the plating problem there's an H-VW-M Mercil Type Cylinder built for the job. For example . . . Plexiglas, with ribless, one-piece, convex panel construction—ideal for temperatures to 180°F. . . . or Melamine, for use in temperatures to 210°F. Every type is available in a wide variety of sizes—with a broad choice of contacts—in addition to the standard flexible dangler. Individual motor drive is standard equipment, although bevel-gear drive is available if desired. You'll get a better plated product from these barrels—a more uniform deposit—*much more economically.*

Plating barrels are just one of many results of over eighty years of constant plating development — a continuing policy summed up in H-VW-M Platemanship . . . your working guarantee of the best that industry has to offer— not only in plating barrels—but in every phase of plating and polishing.

8655

Photo courtesy of H. L. Judd Co., Wallingford, Conn.

For full information on H-VW-M Mercil Type Plating Barrels ask for Bulletin PB-108.

Your H-VW-M combination — of the most modern testing and development laboratory — of over 80 years experience in every phase of plating and polishing — of a complete equipment, process and supply line for every need.

HANSON-VAN WINKLE-MUNNING CO., MATAWAN, N. J.

PLANTS AT: MATAWAN, N. J. • ANDERSON, INDIANA
SALES OFFICES: ANDERSON • BALTIMORE • BOSTON CHICAGO • CLEVELAND • DAYTON • DETROIT • GRAND RAPIDS • LOS ANGELES • LOUISVILLE • MATAWAN MILWAUKEE • NEW YORK • PHILADELPHIA • PITTSBURGH ROCHESTER • SPRINGFIELD (MASS.) • STRATFORD (CONN.) UTICA • WALLINGFORD (CONN.)

H-VW-M

INDUSTRY'S WORKSHOP FOR THE FINEST IN PLATING AND POLISHING PROCESSES • EQUIPMENT • SUPPLIES

COST DETERMINATION IN THE INDUSTRIAL CHROMIUM PLATING JOB SHOP*

WILLIAM F. WALTON† AND PIERRE B. LONSBURY†

Introduction

The pricing system used in the industrial chromium plating job shop must be simple enough to allow for quick, easy estimates and quotations with a minimum of clerical help and paper work. It must be accurate enough to insure consistent profits without overpricing the operator out of competition.

There is presented in this paper a system for determining prices which has enabled the authors' shop to show consistent profits for fifteen years and to maintain a favorable competitive position during this time.

Tank-Hour Rate System

In an approach to this problem, the tank-hour rate has been adopted as the basic factor for determining charges. This, of course, means that the time employed by each chromium plating unit is sold for a certain number of dollars per hour. Realizing that all operations in the industrial chromium plating plant are auxiliary to the chromium plating operations, the authors, therefore, established tank-hour prices in such a manner that the basic rate for a group of chromium plating tanks included all operating costs fundamentally necessary to do the normal variety of industrial chromium plating work. Taken into account in this rate were cleaning and plating chemicals, power, heat, maintenance, shipping and administrative costs and a profit figure. To these costs was added a certain amount of plating labor, based upon the experience that operations, day in and day out, require a certain number of platers for a particular group of tanks for the normal or ordinary varieties of work. Men are needed to clean, rack, load and unload the work, and check operating conditions. Charges for such labor were then apportioned to the tanks in a group, according to the capacities of the tanks; and a rate per hour for each tank was determined which rate entitled the tank to a certain amount of labor per operating hour. In apportioning these costs to the tanks, it was acknowledged that a jobbing operation can never depend upon an even flow of business, and therefore can not provide just enough equipment to handle the incoming work in exactly eight hours a day. There must be enough equipment to handle the high points in the ordinary fluctuations in volume. This means that, as an average, costs must be paid and profits must be made in less than a full day of tank operations. Therefore, based upon experience and an estimate of the work available, tank-hour charges were set so that less than a full working day would give the required return. It may be found, for example, that one chromium plating unit, to be profitable, must earn $16.00 per hour, and is entitled to one man-hour of labor per operating hour. On this basis, a unit of one quarter the capacity would sell for $4.00 per hour, and need one-quarter man-hour per hour of operation.

It should be stressed that the above specified figure is an arbitrarily assumed amount and not a price in actual use. Operating costs vary from shop to shop, with the greatest variations being in labor, power, rent and taxes. Any figure quoted for one shop could be very unreal for operations in other shops. Each shop's rate must be based on its own operations over a period of time, and should be corrected from time to time for changing conditions.

This, then, is the fundamental rate upon which the authors base all quotations and charges.

Extra Charges

To this basic charge for the use of chromium plating facilities are added any extras which may be called for by any extraordinary requirement of the job. Such extras include any polishing, pickling, stop-off work, unusual requirements in handling, also any plating labor beyond the amount allowed for in establishing the tank rate. These charges for labor plus materials plus overhead are on a basis determined by standard accounting procedures.

Special Racks and Conforming Anodes

One other extra must be added in certain cases, namely the charge for special racks and conforming

*Presented at the Fortieth Annual Convention of the American Electroplaters' Society, June 16, 1953.
†Walton & Lonsbury, Attleboro, Mass.

anodes. This extra charge is also determined on a labor plus materials plus overhead basis. Then one of two methods may be followed in passing these costs on. The authors sometimes make a direct fixture charge, always with the stated understanding that the fixtures are their property, to do with as they please. On the other hand with a contract for a fixed number of pieces, the fixture charge may be pro-rated over the total contract number.

The Pattern of Price Determination

For Production Runs

Price determination, using the described factors, takes the following pattern. A study is made, using time, temperature, and current density charts, to find the necessary tank-hours in the most suitable plating tank, and the number of pieces per load. Total elapsed time *must* be calculated including loading, unloading and special set-up times. The number of tank hours times tank rate divided by the number of pieces per load gives the tank charge per piece.

Extra costs, as listed previously, are then determined and calculated on a per piece basis.

Necessary special fixtures are studied, designed, and an estimate of their cost prepared by the proper department. This estimate must be prepared very carefully, with full understanding of the requirements of the job. For instance, if only one or a few pieces are to be plated, expensive insulation and reusable stop-offs are not justified, racks may be assembled with clamps, and less durable materials may be used. If, however, a production quantity is contemplated, the racks and conforming anodes should be designed with maximum durability, ease of maintenance and handling, and quick racking and unracking in mind. Required rates of delivery also must be considered, as these rates will determine the number of racks to be built. It is very uneconomical to build racks that will produce a complete job in six days when the customer requires only a quarter of the total in that time. On the other hand, it can be uneconomical to build less racks than a tank can handle at one time, thereby necessitating operating a tank at less than full capacity. Also, it is well to keep in mind the stock of obsolete racks that may be altered at a saving in cost. Possible maintenance of these fixtures over the life of the contract is included in the basic fixture cost. If the fixtures are to be charged as such, this total amount is quoted or billed. If the charge is to be amortized, the per piece charge based on the total contract quantity is calculated.

The tank charge, plus, if necessary, extra and fixture charges are added to give the final charge or quotation.

For Non-repetitive Work

The method described so far is suitable for production work, and for work large enough to use the capacity of one tank. Non-repetitive small lots, such as salvage work, tools, molds, etc., do not fall easily into this method of pricing. Usually this type of job requires a disproportionately large amount of labor, and a very small amount of actual tank capacity. Often these jobs can be fitted in with production work, or combination tank loads made up of a number of such jobs. For this kind of work, a charge is made for all labor and materials at standard cost, profit, and overhead, then a plating charge is added based upon the number of ampere hours consumed. This ampere-hour charge must be set to give a higher return than the tank-hour charge since all along the line costs of handling this work are greater in proportion to return.

For Special Work

There are several special circumstances that should be considered in pricing or quoting any job. The first of these is the job for which unusual complexities caused by close tolerances, difficult to plate parts or other problems makes the estimation of costs of operation impractical. In such a case it can be most foolhardy to give a firm price quotation. The losses that might be suffered this way can endanger the life of an industrial chromium plating establishment. The easiest solution to this problem would be one involving completion of the work followed by preparation of the bill. However, for production work, this is often not acceptable. Another answer may be one where everything is figured high, and then a large contingency fund is added. In other words, a figure is quoted so high that short of a complete catastrophe it is impossible to lose money. This method, however, can lose jobs. The most satisfactory approach is to ask for and process a trial lot, thereby establishing the costs of doing the work. Another type of work that must be considered carefully is the job that is especially susceptible to damage from rough handling because of the nature of its finish, or where the value of the parts is so high that all through the shop extra care must be taken to such an extent that handling costs are higher than normal. Then there is a special great class of conditions often called "customer vagaries". A few of these are: those who insist on taking unearned discounts; those who call by telephone, collect, to inquire about deliveries; those who insist upon unreasonable deliveries; those who are plain ornery. These and many other customer foibles increase the cost of doing business. They can be evaluated only from experience, and for these a "factor *X*" is reserved which should be added only as judgment determines.

Elapsed Time Factor

A further factor that must be assessed very carefully in using this method of pricing is the total elapsed tank time used for each load. It is necessary to consider that each job starts from a bare tank insofar as tank setup time is considered, and that the tank setup will be torn down after each load. Many times the preceding and succeeding loads will require different

anode and cathode bars, different anodes, perhaps different temperatures. The only time it is reasonable to depart from this principle is when a particular contract promises enough volume at such a delivery rate that succeeding loads of the same work may be run in one tank, in which case it is proper to charge one setup and one tear-down to each series of runs.

The methods described probably are not greatly different than are used in most shops doing industrial chromium plating. Probably the greatest difference is in the authors' method of including enough labor in the tank-hour charge to keep plating operations moving. This is a great advantage in preparing quotations since in a large proportion of the cases inspection will show that no special fixtures or extra operations will be necessary. Thus, there is only one figure to deal with, the tank-hour charge. If extras are necessary, there is the simple formula to determine their cost.

Paper Work

In order to keep at a minimum the operationally necessary paper work, the authors use only two standard paper forms, exclusive of invoice and statement forms. These are: a factory order form, prepared in duplicate and consecutively numbered; and a packing list. Since practically all incoming work is accompanied by some packing slip, bill of lading, or order, no receiving slip is necessary for the receiving clerk to transmit information about incoming work to the office.

Factory Orders

All information pertinent to a job is written up on the factory order by the office. This includes shipping and receiving, plating and billing information, and any necessary special instructions. The original of this form stays in the office, and becomes part of the file record on the particular job. Pricing information is kept on this copy, and invoices are made from this information. This copy, and all its accompanying records, are kept in an open order file until the job is completed and billed, when it goes to the customer files. The carbon of this form goes into the factory, and serves as the instruction sheet and shop record sheet, following the job until completion. Then it goes to a special file where all factory order carbons are filed consecutively according to number.

Packing Slips

All outgoing shipments are accompanied by a packing slip, made in the office from information provided by the shipping clerk. A carbon copy of this slip is prepared, and signed by the person taking the shipment from the factory. This signed copy is then returned to the office as evidence that the job has been completed. From this information and the factory order, invoices are prepared. Not until the packing slip and the factory order are in agreement, and the invoice number has been entered on the factory order are these forms transferred to the customer file and the job file considered closed.

TABLE I. HARD CHROMIUM PLATING INFORMATION FORM

Date	By
Rack No. & Time	
Cleaning	
Anode Spacing	
Tank No.	Volts
Amps.	Temp. Time
Polishing	before
	after
Results	
Remarks	

Plating Information Form

It has been found that an adequate and easily available source of technical information on past jobs is essential to the smooth running of a job-shop business. Such information is used to check continuously the accuracy of pricing and quoting methods, thus keeping the personnel who have any cost estimating duties right up on their toes. It gives access to a great store of past performance records on plating procedures, enabling one often to foresee and forestall plating and operating troubles, and to make more accurate estimates and quotations. The easiest method the authors have devised for assembling and maintaining this information is as follows: On the back of the factory copy of the factory order and of the office copy of the packing slip a form is imprinted calling for some fifteen pieces of plating information, such as temperature, amperes, time and including results and remarks. (See Table I.) The shop men use their copy of the factory order to keep a record of the essentials of their operations and are encouraged to describe any unusual problems or solutions of problems quite fully. Of course, the back of this form is sometimes not large enough for remarks, in which case another sheet of paper can easily be stapled to the form. Before any order is transferred from the open file, the packing slip with the information form on back is compared with the factory record and information especially pertinent to pricing is transferred to the packing slip. Without this information, the job file may not be considered closed.

Therefore there are two reservoirs of information, the shop copy of the factory order filed numerically, and the office copy of the packing slip, filed by customer names. The shop men keep a special index, by classes of work of unusual nature, identified by factory order number, for quick access to such information. Information on previous work of similar nature for the same customer, or a customer who has the same type of work, is obtained easily from the customer files.

These methods of accounting and record-keeping have not been found to be burdensome; clerical expense has been found to be exceptionally low in comparison to sales.

Conclusion

It is hoped that this explanation of the methods used is clear enough and complete enough to be of value to any who may have need for such a system.

In closing, the authors wish to point out that a good pricing, accounting, and record-keeping system in itself will never make money. It can only safeguard the profit that is made on the shop floor from the business that has been produced by sales effort. Effort, ingenuity and careful administration of the operations at the polishing lathe, rack building bench, and plating tank will never take second place in insuring profitable industrial chromium plating.

DISCUSSION

Mr. A. T. Patterson (Patterson Plating, Toronto, Canada): Talking about exclusive, elusive profits, what would be the per cent of profits on shops of that type for a healthy industry, and what would be the gross sales per year of something like your business?

Mr. Lonsbury: I would prefer not to state our own profit percentage or gross sales.

I have not enough knowledge of operations in other shops to state what profit percentages should be. I would judge that there should be a 10 per cent in a modest year, more in a good year, to insure survival in a poor business period.

Probably the greatest problem in job shop operations is the fluctuation in amount of work in the shop. General Motors can schedule production months ahead, but the job shop operator is lucky if he can schedule for a week ahead. With only a few days' notice he may drop to half his capacity. Therefore, he cannot figure on too close a profit margin. I would, therefore, qualify my first statement and say 10 per cent for a fairly large stabilized operation in a diversified industrial area up to 20 per cent in smaller operations or in unstable or seasonal industry areas.

Mr. F. A. Trudem (Southern Finishers, Nashville, Tenn.): Over a period of operation, have you been able to obtain a cost of chromium plating on the basis of square inch per unit thickness?

Mr. Lonsbury: We sometimes do that, subject to variations and improvements with use. For certain regular shaped types of work, certain work that is quite competitive, often we do establish a square inch figure for plating and sometimes a square inch price that includes both polishing and plating, if necessary. It should be done only on the basis of some experience.

Question from the floor: We would appreciate your comments on how to handle or dismiss the individual who comes in with one part, saying "there are millions", but he wants you to do the one part.

Mr. Lonsbury: There are certain places where the value of the chromium is unquestioned and the application is not in any way an experimental or sample thing. We know it will work; in that case, we charge a minimum. On the other hand, we have done sample work gratis when it is apparent that the man is sincere and there is a good future possibility. We consider that more in the nature of sales expense.

Mr. Herbert E. Fennel (Heintz Mfg. Company, Front and Olney, Philadelphia, Pa.): I want to say first, that when you make these technical talks, you are not only talking to your own groups, sometimes there is a fellow on the other side of the fence, so this should be kept in mind before you give away these factors. I long suspected this would get a confirmation. I would like to give you our side. Consider the unreasonable fellow who is always kicking you in the pants if you are doing work in a plating factory. Many times you're not doing the job for the man who is going to use the article, but for the man who is going to sell the article; he is also pushed by that unreasonable factor. A lot of times we are so-called unreasonable because we have a demanding customer behind us. Your X-factor—if you are making it for an organization that is manufacturing its own products, should be imposed on them, but if you are making it for another jobbing shop, give us a little room for our X-factor.

On the unreasonable production figure, I have also met the shop that, to get our job, gives us a good delivery date. After it has our job, it pushes a rush job, coming in later, in preference to our order which he already has.

Finally, the special handling on which you want to put an extra charge—let's make sure it is special handling that it gets. I agree that there should be an extra charge if you have to handle it with unusual care in production or shipping, but let's not make everything a special handling job to the detriment of the handling of the ordinary job which may be the most stable business.

Mr. Lonsbury: I can see the other side of this discussion, too.

Mr. George M. Long (Aetna Electroplating Company, Philadelphia, Pa): I want to congratulate you on your paper, Mr. Lonsbury—it is a very good, practical paper. I am a little concerned about your methods of pricing—in other words, you have about three different methods of pricing. . . . For example, a tapered shaft where you shield, of course, the tapered end—and use 2 amperes per square inch in plating. I assume you would charge by the ampere hour, for such a piece instead of by your tank-hour method.

Mr. Lonsbury: Yes.

STABILITY OF ION EXCHANGE RESINS TOWARD CHROMIC ACID PLATING SOLUTIONS*

C. F. PAULSON† AND G. H. SAUNDERS‡

Introduction

Treatment of chromic acid solution by cation and anion exchange is now an accepted process in plating plants. Costa first published[1] the results of his preliminary experiments on cation exchange in February, 1950. It was soon thereafter that the authors' company installed the first commercial scale unit of this type at Grumman Aircraft Engineering Co., Bethpage, N. Y. In the short span of three years, the process has become widely recognized and appreciated. Now, more than a dozen plants are using this process on a commercial scale and numerous others are evaluating it for their purposes.

The cation exchange process was discussed[2] at the 39th Annual American Electroplaters' Society meeting and some of its strong and weak points described. Essentially, a cation exchanger in the hydrogen cycle is used to remove metallic cations from chromic acid solutions, substituting hydrogen cations and reconstituting the chromic acid from its salts. When the cation exchanger becomes exhausted, it is regenerated by passing a strong acid solution through it.

Discussion

Costa reported[1], upon his tests with a commercially available sulfonated polystyrene cation exchanger. He found that in solutions containing 100 g/l of CrO_3 or less, removal of metallic cations was essentially complete. In solutions containing above 100 g/l of CrO_3, the effective capacity and degree of completion of metal cation removal were both reduced. In solutions containing more than 150 g/l of CrO_3, he found attack upon the resin, as evidenced by formation of trivalent chromium. He tested anodizing baths, copper stripping baths and chromium plating baths, both with and without dilution.

Use in Anodizing Plants

This basic process is most applicable in anodizing plants where solutions containing less than 100 g/l CrO_3 are customarily used. Dilution is therefore not necessary. The acceptance of the process has been excellent and it will probably not be long before all anodizers of appreciable size will employ cation exchange. At frequent intervals, a portion of the bath is withdrawn and passed through a cation exchange unit and then back to the anodizing bath. The cation exchanger is operated beyond breakthrough to exhaustion as complete removal of the cations from the anodizing bath is not desirable. The chromic acid remaining in the cation exchange bed when the bed becomes exhausted is displaced by water and returned to the anodizing tank. The small amount of dilution which results can generally be tolerated since it makes up for evaporation and dragout losses.

Use in Electroplating Plants

Electroplating operations, on the other hand, have necessitated a more complex treatment method due to the inability of the cation exchangers to withstand 400 g/l CrO_3 solutions. In 1952 the recovery of a hard-chromium plating solution was described[2] at the technical sessions of the 39th Annual Meeting of the American Electroplaters' Society. In that report the authors stated that the plating solution was diluted, passed through the cation exchanger, and then all of the resulting solution containing chromate was concentrated back to plating strength in a glass-lined evaporator.

The need for the evaporator, unless it is also necessary to concentrate the save rinse solution, places a very heavy capital load upon the process. The result has been that many decorative chromium plating plants have felt that it was better to tolerate the high metal cation content in their baths than to try to take it out. This is done in spite of the greatly increased electrical efficiency of the treated bath. Hard-chromium platers, however, find the process economically feasible because they can tolerate less impurities in the bath without an adverse effect on throwing power.

*Presented at the Fortieth Annual Convention of the American Electroplaters' Society, June 16, 1953.
†The Permutit Company, New York 36, N. Y.
‡The Permutit Company, Birmingham, N. J.

TABLE I. COMPARISON OF OPERATING METHODS*

	Method 1	Method 2
Influent CrO_3	394	384
Influent Cu	10.9	9.8
Influent Cr^{+++}	0	0
Effluent CrO_3	348	387
Effluent Cu	5.9	8.3
Effluent Cr^{+++}	0	0

*Values given in grams per liter

Experimental Evidence

The desirability of treating a plating-strength bath directly by cation exchange was obvious, so the authors undertook to investigate the possibility of developing a practical process. First tests were run with a sulfonated polystyrene cation exchanger*. It was found that reduction of the metal content in 400 g/l CrO_3 solutions was possible but that the capacity was low; above 200 g/l, there was some resin degradation as evidenced by the reduction of CrO_3 to Cr^{+++}, and bleaching and swelling of the exchanger.

Modified Resin Used

The authors, having established that this resin was not sufficiently stable, developed several cation exchangers for handling 40 per cent CrO_3 solutions which gave promise of greater oxidation resistance. One of these identified as a modified sulfonated polystyrene† performed well when tested. Its capacity for metals in chromic acid was almost identical with that of the resin first used, but no physical or chemical breakdown was encountered using 400 g/l CrO_3 solutions.

The solution used in these tests contained approximately 10 g/l of copper. In typical runs, during which the breakthrough was considerably overrun, the copper concentration was reduced by 20–40 per cent. No Cr^{+++} was encountered in the effluent. Up to 14 cycles were run on individual resin samples and there did not appear to be any reduction in capacity.

Method #1

Tests were run in two different manners. In the first, several volumes of strong CrO_3 solution were allowed to percolate through a bed of the modified exchanger. The water initially in the bed was displaced to waste, then a quantity of solution equivalent to that introduced was collected by draining the bed. This resulted in the loss of some CrO_3 held up in the modified resin.

Method 2

The second method was essentially the same except that after introduction of the strong CrO_3 solution, water was introduced and allowed to percolate down through the bed displacing the CrO_3. This resulted in the overall dilution of the influent but recovery of all the chromium. Two parallel tests are shown in Table I.

The mechanism of ion exchange depends upon diffusion of a portion of each ionic constituent into the ion exchange particle. Initially a regenerated particle is filled, much like a tiny sponge, with water. When the chromic acid is introduced, part of the CrO_3 enters the particle and displaces some of the water. Thus the exhausted resin particle contains some CrO_3. Introduction of water reverses the equilibrium and the CrO_3 is removed from the particles.

For Method 1, the apparent holdup amounted to 140 grams CrO_3 per liter of resin. It required an additional 1.2 liters of water per liter of the modified resin to recover this CrO_3. To recover all of the chromium in a typical experiment would result in 25 per cent dilution of a 400 g/l solution. Otherwise, losses would approximate 10 per cent of the CrO_3. The losses are in direct proportion to the degree of contamination of the CrO_3 solution, since the volume treated is in inverse proportion to the contamination.

Regenerant Tests

Tests were made with the original and the modified sulfonated polystyrene cation exchangers to determine the effect of regenerant upon capacity. Sufficient confirming data were developed upon the special resin to indicate that results were almost identical with those obtained for the conventional material. Increasing regenerant dosage increased capacity, although not proportionately. Increasing regenerant concentration from 10 per cent to 30 per cent decreased capacity. Hydrochloric acid was found to be a more efficient regenerant than sulfuric acid in terms of pounds, although in terms of dollars such may not be the case. One major advantage of hydrochloric acid is that a higher capacity is achieved. A higher resin capacity results in less dilution or chromate loss, depending upon which operating method is resorted to. Hydrochloric acid is warranted where a low initial cost is preferred to a minimum operating cost.

The cost of the hydrochloric acid regenerant is approximately 1/3 of the value of the recovered CrO_3. Thus the treatment is economically very attractive, particularly in locations where there are waste disposal problems.

Operating Costs Data

The operating cost of treatment of a strong chromic acid solution at any concentration is the sum of the costs of regenerant chemicals, and steam for evaporation back to the initial concentration, plus amortiza-

*Permutit Q
†Permutit QC

TABLE II. BASIS FOR COST CALCULATIONS

Volume to be treated	5000 gal
Analysis when ready for treatment	400 g/l CrO_3 5 g/l Cr^{+++} 5 g/l Fe^{+++} 2 g/l Cu^{+++}
Rate of cation buildup	0.2 g/l cations per day
Cost of CrO_3	28¢ per lb
Cost of H_2SO_4	2¢ per lb
Cost of Steam	75¢ per 1000 lb
Operating Year	250 days

tion of ion exchange unit and evaporator. The authors surveyed the effect of the concentration to which an initial 400 g/l solution as given in Table II is diluted upon the operating cost of the overall treatment.

The minimum dilution possible is 25 per cent so the figure covers only lower concentrations. Thus in operation the water used to displace the CrO_3 from the modified resin at the completion of one cycle would be used to dilute the plating solution prior to the next cycle. More water could obviously be added to give greater dilution. Any concentration below 300 g/l can be treated.

Fig. 1, based on the data shown in Table II, indicates that treatment should be carried out at as high concentration as possible. Some items were neglected (such as labor, electrical power and cooling water) but these are either minor or not changed appreciably with concentration. If one assumes the bath must be dumped when it reaches the concentrations of cations listed above (because, for instance, of its poor throwing power) the yearly replacement cost of chromic acid without ion exchange would be $19,850. Thus the treatment cost at 300 g/l of $7,700 would be rapidly repaid.

TABLE III. STABILITY OF A HIGHLY BASIC ANION EXCHANGER IN CHROMATE SOLUTIONS

Concentration ppm CrO_3	Acid Solution H_2CrO_4	Alkaline Solution
100	Excellent	Excellent
500	Excellent	Excellent
1,000	Excellent	Excellent
5,000	Good	Good
10,000	Fair	Good

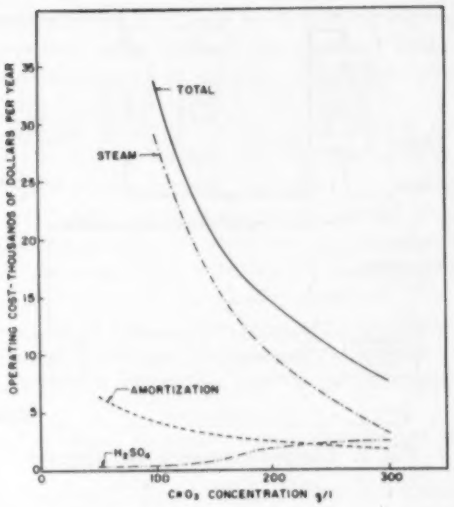


Fig. 1. Removal of metals from chromic acid plating solutions. Effect of dilution upon operating cost

Anion Exchanger Stability

There has been considerable discussion on the stability of anion exchangers when treating dilute chromic acid rinse solutions. The use of ion exchange for recovery of chromate from rinse waters and purification of these rinse waters has much to recommend it. Compared with conventional waste disposal processes, it is the only method which pays its own way in terms of the chromic acid recovered. Its application automatically results in the formation of demineralized water which is excellent for rinsing purposes.

The authors have discussed previously[3] the accelerated laboratory and plant scale tests that were made to determine the stability of a highly basic anion exchanger*, when contacting chromic acid. Table III shows the relative stability of that basic anion exchanger in acid and alkaline solution. At 1000 ppm CrO_3 content and below, the resin maintains its operating capacity exceptionally well over long periods of time either in acid or alkaline solutions.

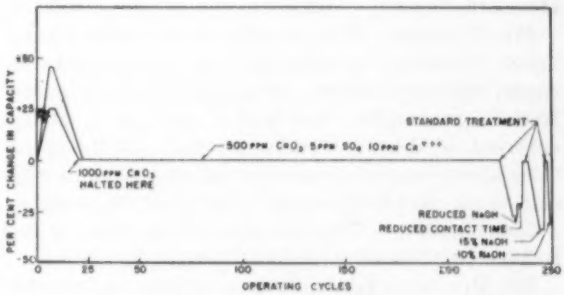


Fig. 2. Stability of a highly basic anion exchanger. Life tests on contact with chromic acid

*Permutit S

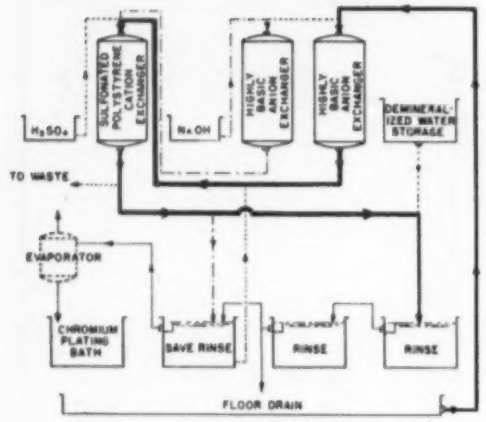


Fig. 3. Chromate recovery flow diagram

Leakage

Long term tube tests also have been made at various CrO_3 levels to confirm these findings. Fig. 2 shows the operating capacity of the basic anion exchanger when treating a solution of 500 ppm CrO_3, 5 ppm SO_4 and 10 ppm Cr^{+++} expressed as per cent change in original capacity. It was found that leakage of CrO_3 through the resin increased slightly as the test proceeded. However, it was always below 10 ppm. Since the water was recirculated in a closed cycle, the leakage did not result in a loss in CrO_3 nor did it constitute a waste problem. This concentration should be satisfactory in a final rinse bath. A rinse water of 500 ppm is higher than would occur in most operations thus the leakage found in the test is greater than actually would be encountered. The leakage is a function of the influent concentration so that in lower concentrations the leakage would be negligible.

Plant Scale Experience

Plant scale experience in many locations generally has confirmed these laboratory results. It has also been found that in several locations where the treatment was carried out at elevated temperatures there was little or no harm to the resin.

The authors conclude from the laboratory and numerous plant scale installation tests, that the method of operation shown in Fig. 3 is most satisfactory. The rinse water is withdrawn and passed directly to the highly basic anion exchanger where the chromate is removed. No neutralization prior to anion exchange treatment seems necessary. The effluent from the anion exchanger goes directly to the sulfonated polystyrene cation exchanger where traces of cations are removed and then the demineralized water is returned to the rinse tank.

When the anion exchanger becomes exhausted, caustic soda solution is sent in series through it and the cation exchanger. The effluent is H_2CrO_4 which can be used as produced, or concentrated for addition to the bath.

The recovery process is of value to the plater and metal finisher in several important respects. It eliminates a serious waste; it recovers a valuable chemical; it improves the quality of work.

LITERATURE CITED

[1]R. L. Costa, Ind. Eng. Chem. 42, 308 (1950).

[2]L. Gilbert, W. S. Morrison and F. H. Kahler, "Use of Ion Exchange Resins in Purification of Chromic Acid Solutions", Proc. Am. Electroplaters' Soc. 39, 31 (1952).

[3]Purdue Univ. Eng. Bull., Extension Ser. Vol. 36, No. 6, 209, November, 1952.

DISCUSSION

MR. GILBERT (Rock Island Arsenal, Rock Island, Ill.): I note from Table I of your paper that no mention was made of trivalent chromium ion. That is, by far, the foremost contaminant of most hard-chromium plating solutions. I wonder if you could give us some idea of the capacity of the resins in terms of equivalents.

MR. PAULSON: The capacity of the resins for trivalent chromium is comparable to their capacity for copper and other cations. In treatment at high concentrations, incomplete removal of cations is always achieved, so there is no differentiation. In the operations where complete removal is desired, it is more difficult to get complete removal of trivalent chromium.

MR. GILBERT: Then, in other words, there is bed leakage of trivalent chromium through the system.

MR. PAULSON: Yes, in all cases, in these concentrated solutions, there is leakage of every cation.

MR. GILBERT: Could you give us some idea of the total capacity of this new resin in terms of equivalents?

MR. PAULSON: As I said, it is comparable to the previously used resins in dilute concentrations and falls off in more concentrated solutions.[1,2,3]

MR. GILBERT: In other words, around 2 normal?

MR. PAULSON: We have found that normality bears a much smaller effect than the *p*H of the influent solution. The *p*H of the influent solution is a major criterion. Above *p*H approximately 0.22–0.25 the capacity is rather high; whenever you get below that *p*H, whether in concentrated solution or dilute solution which contain a small amount of contaminants, the capacity falls off.

MR. GILBERT: Under those circumstances, would it not be true that the efficiency of the recycling of the solution would drop with the increasing purity of solution? In other words, the law of diminishing return would prevail.

MR. PAULSON: The capacity falls as the concentration rises. However, as I pointed out, the overall treatment becomes more attractive as the concentration rises.

MR. GILBERT: I note that you recommend the use of hydrochloric acid as a regenerant. Does this not

seem to be a hazardous procedure in view of the fact that while leakage or inad ertent introduction of sulfuric acid to the bath can be removed, the chloride ion is much more difficult to remove from the solution?

MR. PAULSON: We think that is a function of equipment design. With proper design, no chloride will leak into the bath. Also, as shown in the text, normally we do use sulfuric acid; it is only in the treatment of small baths where high CrO_3 concentrations are desirable that we recommend the use of hydrochloric acid for its higher resulting capacity.

MR. GILBERT: What are the concentrations of the regenerants, sulfuric and hydrochloric acids?

MR. PAULSON: The optimum for both is between 10 and 25 per cent.

MR. H. A. FUDEMAN (Trico Products Corp., Buffalo, N. Y.): Have you studied the effect upon your resins of the fluoride type catalyst baths that are sometimes used in chromium plating?

MR. PAULSON: We have studied proprietary baths containing large amounts of fluoride such as are used in aluminum surface finishing and found there was no particular effect. A considerable amount of work is being carried out on that problem, and as far as we know, no deleterious effect traceable to the fluoride ion has been found.

MR. FUDEMAN: What becomes of these catalysts in the process?

MR. PAULSON: Sulfate, chromate, and fluoride anions are all recovered by the anion exchangers; they are all unaffected by the cation exchangers. There is evidence to indicate that some sulfate is held by the cation exchanger in a complex with trivalent chromium, but it is a rather minor effect as far as operating conditions go. The same holds true for high speed self-regulating baths which contain cations that have catalytic properties; those cations will be removed along with copper and other cations.

DR. LOUIS WEISBERG (New York, N. Y.): Mr. Paulson, would you care to say how Permutit Q and QC compare in temperature resistance?

MR. PAULSON: Theoretically, QC should be more resistant. Since both are resistant to temperatures of 250° F, the question is an academic one when treatment of chromic acid solutions is concerned.

MR. J. M. ANDRUS (Croname, Inc., Chicago, Ill): Does the ion exchange system remove strontium which is used widely in chromium plating for self-regulating purposes?

MR. PAULSON: It would remove some of the strontium.

MR. GEORGE E. BEST (Mutual Chemical Company of America, Baltimore, Md.): As far as the two resins are concerned, Q and QC, what is the cost on a purely relative basis?

MR. PAULSON: The Permutit QC is about 20 per cent higher.

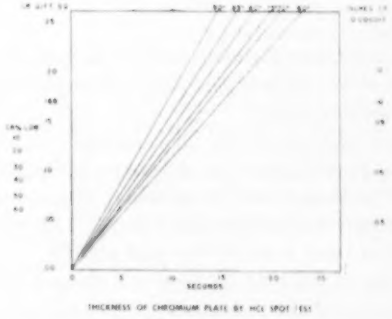
MR. BEST: With reference again to trivalent chromium, have you explored the chemical preoxidation of trivalent chromium prior to cation exchange treatment?

MR. PAULSON: We have not explored that problem. However, since you must take the solution out of the plating tank for treatment in other equipment, the conditions are good for any oxidation process. Where the trivalent chromium is a relatively unimportant conconstituent, it is probably more economical to forget about oxidation. Where it is the main constituent, oxidation effects should be considered along with some simple method for avoiding them.

● ● ●

Thickness Test for Decorative Chromium*

A spot test for the thickness determination of decorative chromium plate requires reagent grade hydrochloric acid, a stop watch, wax marking pencil and thermometer. At each test spot of a clean dry surface area, ¼-inch in diameter, is marked off with the pencil. After the article stands long enough to reach room temperature (65–85° F preferred; note within 2° F) one drop of acid is placed within the wax ring. The time elapsed between the start of gas evolution and first appearance of basis metal or intermediate plate is measured to the nearest ½ second (Stop watch). If bubbling does not start at once, the surface of the chromium within the ring may be touched with a fine nickel wire.



From temperature-elapsed time data chromium thickness can be determined (Fig. 1).

*From data in "Chromic Acid in the Metal Finishing Industry." Diamond Alkali Company, Cleveland, Ohio (1953)

QUESTION BOX — readers' questions of general interest

Q. 164. What is more advisable to use for chroming engraving rolls for textile industries—a vertical or horizontal tank?

A. Rolls or rollers may be chromium plated in either the vertical or the horizontal position, and both positions have their advantages and disadvantages. The advantages of vertical plating are that the rolls are held stationary in simple racks and that the ends of hollow rollers or shells can be easily sealed to prevent solution from etching the inside. The disadvantages of vertical plating are that the depth of the tank and the headroom above the tank must exceed the length of the rolls; and that continuous mechanical or air agitation of the solution is required to make the temperature of the solution the same at the bottom of the tank as it is at the top, so that the lower ends of the rolls will not plate heavier.

The advantages of horizontal plating are that an ordinary plating tank with ordinary headroom can be used and that no equipment is required to agitate the solution. The disadvantage of horizontal plating is that a motor-driven mechanism is required to keep the rolls continuously oscillating or rotating to insure uniform plate. Maintenance costs of horizontal plating are higher and more floor space is required. Most new installations for chromium plating engraved rolls for the textile industries are designed to plate the rolls in the vertical position.—J. M. Hospowich.

Q. 165. Do you know of an instrument that will measure the thickness of a non-magnetic metallic coating such as molybdenum or copper on a non-metallic such as glass?

A. There is available a gamma radiation type instrument (name of supplier was furnished) which will measure accurately in the range suggested—(0.005 inch differences plotted across a 10-inch scale)—and appears to be of practical use in this problem.—Anon.

Q. 166. What is the most modern method for quantity production, to 24 karat gold flash (electroplate) zinc permanent mold castings?

A. Gold plating of zinc die castings would involve the same pretreatment as chromium plating the same item. The item would be polished, cleaned and then bright copper and bright nickel plated. After adequate rinsing the work is ready for gold plating.

The size of the gold solution will depend on the size of the item and the volume of production. The size of the nickel plating racks are also a factor if the item is to be gold plated without reracking. Since the time of plating for a flash deposit is short (10 to 30 seconds) the tank is quite small (40 to 100 gallons). The gold control is low (3 to 5 dwt per gallon). It is also best to modify the solution by adding small amounts of base metals.

The general plating conditions are 140–160° F, 3 to 5 volts, 10 to 30 seconds and no agitation. Such solutions using constant temperature, constant current density, automatic timers, duration of plate and ampere-hour meters for replenishment will give trouble-free constant-color plating. The larger sources of color change are narrowed down to drag in of nickel and organic contamination. Relatively small amounts of nickel will pale out the gold color. Organic contamination will cause a dead or dull appearance and dark streaks. Such thin deposits would be best lacquered if the item is to be handled considerably or exposed to outdoor corrosion.—Edward A. Parker.

Q. 167. We are interested in obtaining details on the immersion plating of steel with cadmium, zinc or tin. We would appreciate any information you could pass along on plating of this type.

A. Immersion tin coatings on steel are covered in the report on a recent (1–11–52) Swiss Patent No. 284,092 issued to Braunschweizer Hüttenwerk. The formulae:

30 g/l stannous chloride
15 g/l cream of tartar with the addition of zinc or
0.35 g/l of stannous chloride and 55 g/l sodium hydroxide

The solution is operated at or above boiling, in the latter case in an autoclave. In contact with, e.g., aluminum, coatings of 0.0001–0.0005 mm are obtained.

Another method for obtaining immersion coatings of tin on steel would be through the use of a preliminary copper plate on the steel followed by immersion tinning in the solution of the following composition:

Sodium cyanide	6–8 oz/gal
Sodium hydroxide	4–5 oz/gal
Stannous chloride	3¼–5 oz/gal
Temperature	90–100° F

Immerse for 30–60 seconds. Rinse in cold—then hot water. Repeat if necessary.

Another method of contact tinplating which was worked out in England is based on immersion of the steel part in the conventional sodium stannate-caustic soda solution. When a light alloy contact (2S aluminum wire or braid) is made with the steel, plating of the part takes place as the aluminum dissolves in the solution. The reports from England on this method have been encouraging, but one or two people who have tried it here find that the rate of plating is much less than reported. Evidently it requires a bit of experimenting to get the right conditions of temperature and solution concentration.—A. Korbelak and R. M. MacIntosh.

project no. 6

project director:
N. THON*

associates:
LING YANG*†
STELLA YANG*

location:
FRICK CHEMICAL LABORATORY

PRINCETON UNIVERSITY,
PRINCETON, N. J.

Acknowledgment is due the Research Committee, Dr. W. A. Wesley, The International Nickel Company, Chairman; the Research Directing Committee, Mr. Guy M. Cole, Ternstedt Division, General Motors Corporation, and Dr. Donald Price, Oakite Products, Inc., Chairman and Vice-Chairman, respectively; and the Project Committee, Dr. Louis Weisberg, Consultant, New York City, Chairman; Dr. B. Egeberg, International Silver Company; and Mr. Clifford Struyk, General Chemical Division, Allied Chemical & Dye Corporation, for their contributions to this project.

*AUTHORS

†Present address: Metals Research Laboratory, Carnegie Institute of Technology, Pittsburgh, Pa.

POROSITY OF ELECTRODEPOSITED METALS

XI. ANALYSIS OF CORROSION PRODUCTS AS A METHOD OF MEASURING THE CHANGE OF POROSITY IN CORROSION

Introduction

In previous communications of this series, a point of view has been stressed repeatedly according to which the corrosion of a protectively coated underlying base metal is primarily due to corrosively developing porosity of the coating metal. The protective value of the latter should be a function of the slowness with which its porosity, as measured by its gas permeability, increases in exposure to the given corrosive medium. To correlate quantitatively the permeability behavior of detached electrodeposited foils with their protective value as adherent coatings, it appeared desirable to devise a method by which the progress of the corrosion could be determined, as a function of time of exposure, in objectively meaningful absolute units.

Corrosion-Product Analysis

Method

Determinations of the amounts of base metal corroded across the coating in stated times of exposure are the obvious answer. In a given corrosive medium, the amount of corrosion products formed, as a function of time of exposure, should correspond to the increase of the porosity of the coating. Such analytical figures are an objective measure of the progress of the corrosion of the base metal, perfectly defined and communicable, and independent of subjective estimations based on mere inspection and comparisons with arbitrary scales of aspect. The amount of corrosion products having exuded through pores and spread over the surface is evidently the closest measure of what, in practice, is referred to as the appearance of the plated article and which, naturally, is the primary concern in many applications. The more corrosion products are formed, the worse will be the appearance of the sample or article. Thus, the "appearance" can be expressed in meaningful figures, more pertinent and informative than such arbitrary devices as the number of rust spots of a conventionally adopted minimum diameter per unit surface area.

Procedure

The problem was to find a way to separate the corrosion products of the base metal from the uncorroded base, in such a way as to (1) collect all the corrosion products, (2) at the same time, be sure not to corrode any more base metal by the very analytical procedure. With iron as a base metal, it developed that there was no reliable way in which the corrosion product—iron oxides—could be dissolved away quantitatively without at the same time attacking to some extent the uncorroded iron metal. The authors tried a number of reagents, particularly acids at various concentrations and with various inhibitors, but could find no reagent fulfilling the above two conditions rigorously and quantitatively.

Rubbing

However, success was experienced by the use of a simple mechanical device, followed by a supplementary standard chemical treatment. The mechanical device consisted in gently rubbing the surface with a rubber-tipped glass rod (a "policeman") such as is commonly used in chemical analysis. By this operation,

TABLE I. RESULTS OF MEASUREMENT OF CORROSION PRODUCTS*†

	Rubbed off	Extractions			
		1st	2nd	3rd	4th
Fe.....	0.06	0.32	0.40	0.32	0.40
Ni.....	0.24	0	0	0	0

*Values given in micrograms per square centimeter of surface area
†10 microns Watts' nickel on iron after 5 hours in hot water

TABLE II. RESULTS OF MEASUREMENT OF CORROSION PRODUCTS*†

	Rubbed off	Extractions			
		1st	2nd	3rd	4th
Fe.....	0.20	0.64	0.72	0.72	0.80
Ni.....	0.24	0.06	0	0	trace
Fe.....	0.16	0.48	0.56	0.60	0.64
Ni.....	0.30	0	0	0	trace

*Values given in micrograms per square centimeter of surface area
†10 microns Watts' nickel on iron after 10 hours in hot water (Data for two different samples)

the major part and sometimes all of the oxidized iron was removed and collected in water which was then acidified to dissolve the oxides.

Leaching

In order to make sure that all of the oxide had been removed, the sample was then treated repeatedly, for definite lengths of time, with an inhibited acid solution which admittedly was strong enough to dissolve, along with any oxide that may have remained on the surface, some of the metal. When all the oxide was removed successfully by the mechanical rubbing operation, it was found that the amounts of iron leached out in the successive applications of the inhibited acid, were equal. When some oxide remained, then the amount dissolved in the first leaching was greater than that extracted in the second, third and fourth leaching; the difference between the first and the consecutive readings corresponded to an additional amount of oxide, and that was added, as a correction, to the bulk of iron oxide detached by the mechanical rubbing.

Sampling Technique

It was found convenient to work with samples 6.4 x 4.6 cm, with the edges stopped off with lacquer*, so as to leave a surface area of 25 sq cm on each side. After exposure to corrosion, the sample was put into a high 150 cc beaker, covered completely with distilled water, and rubbed under water with the rubber-tipped glass rod. The sample was then pulled out, rinsed into the beaker, and leached several times, five minutes each time, in 150 cc of 0.5 *N* sulfuric acid containing 0.5 g/l of thiourea as an inhibitor. The water with the solid iron oxide was acidified with a few cc of 3 *N* sulfuric acid, until a clear solution was obtained. Before analysis for iron by the standard thiocyanate method, the thiourea in the leaching liquors had to be destroyed. This was achieved by adding a few drops of 3 per cent hydrogen peroxide and then evaporating almost to dryness, after which the residues were taken up with 10 cc of water containing a few drops of 3 *N* sulfuric acid.

TABLE III. RESULTS OF MEASUREMENT OF CORROSION PRODUCTS*†

	Rubbed off	Extractions			
		1st	2nd	3rd	4th
Fe.....	0.16	0.80	0.57	0.57	0.60
Ni.....	1.2	0	0	0	0

*Values given in micrograms per square centimeter of surface area
†10 microns Watts' nickel on iron after 20 hours in hot water

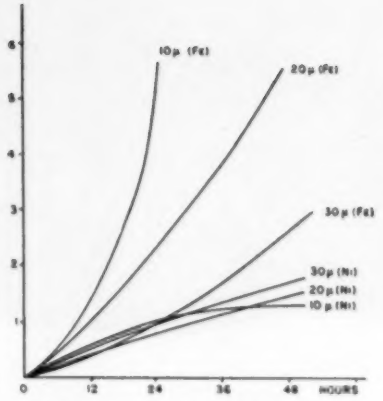


Fig. 1. Iron and nickel corrosion products (in micrograms/sq cm), in intermittent immersion in 1 per cent NaCl solution. Watts' nickel coatings, 10, 20, and 30 μ, on shim stock

Determination of Iron and Nickel

In each solution, iron was determined by the known colorimetric method with KCNS (potassium thiocyanate), against a standard solution containing 0.02 mg iron per cc. For the determination of both the iron and the amount of nickel coating corroded, each solution was divided into two parts. Iron was determined in one half of it. In the second portion, iron was precipitated with ammonium hydroxide, and the nickel determined in the filtrate by the standard colorimetric dimethylglyoxime method, against a solution containing a known amount of 0.02 mg of nickel per cc.

Determination of Copper

For the determination of copper, when that metal was used as an intermediate layer between the iron and the nickel, the solution was divided into three parts, one for the determination of iron, the second for nickel and the third for copper. In the third portion, both iron and nickel were precipitated with ammonium hydroxide plus dimethylglyoxime, then the excess ammonia was evaporated from the filtrate, and the copper was determined by the standard colorimetric $K_4Fe(CN)_6$ (potassium ferrocyanide) method, against a solution containing a known amount of 0.02 mg of copper per cc.

*Microtex.

Correction Factor

The following examples illustrate the procedure of correction by consecutive leachings with inhibited acid. A sample of rolled iron, lightly etched, and coated on each side with 10 microns of Watts' nickel, was exposed to hot water of 95° C. After definite times of exposure, the amounts of iron (base metal) and nickel (coating) corroded were determined as described above. Tables I and II give the amounts corroded, in micrograms per sq cm surface area, obtained by mechanical rubbing, and in the first, second, third, and fourth, leaching with the inhibited dilute sulfuric acid, after 5 and 10 hours of exposure.

In both instances, the mechanical rubbing evidently had been complete as far as iron was concerned, and no correction had to be applied. From the fifth extraction on, the amounts leached by acid began to increase, evidently owing to increased attack. This, however, had no bearing on the determination of the corrosion products.

After longer exposures, it was found occasionally that the mechanical rubbing had not yielded all of the oxide, and there was need for a correction. This is illustrated in tables III and IV.

In Table III, the rubbing off operation had evidently been botched. Out of the amount of 0.80 micrograms/sq cm leached out in the first acid extraction, only 0.57 could be iron metal, the balance, 0.23, was oxide-iron, and the true amount of iron oxidized was therefore 0.16 + 0.23 for a total of 0.39 micrograms. In Table IV, the additional amount, about 0.06, was no more than a correction.

The consecutive leachings with acid thus constituted a *check* on the completeness of the first mechanical operation, and, while it may have proved to be negative, this check was felt to be essential.

TABLE IV. RESULTS OF MEASUREMENT OF CORROSION PRODUCTS*†

	Rubbed off	Extractions			
		1st	2nd	3rd	4th
Fe	0.76	0.48	0.40	0.44	0.44
Ni	1.8	0	0	0	trace

*Values given in micrograms per square centimeter of surface area
†10 microns Watts' nickel on iron after 45 hours in hot water

TABLE V. RESULTS OF HOT WATER IMMERSION TESTS*

Medium	Hours	Corroded†	
		Fe	Ni
Hot water, aerated	5	0.06	0.24
	10	0.18	0.30
	20	0.39	1.2
	45	0.82	1.8
Hot water, without air	5	0.02	0.4
	10	0.04	0.4
	20	0.07	1.7

*10 microns Watts' nickel on shim stock
†Values given in micrograms per square centimeter of surface area

TABLE VI. RESULTS OF INTERMITTENT IMMERSION TESTS*

Thickness of Ni (microns)	Hours of exposure	Corroded†	
		Fe	Ni
10	12	1.3	0.30
	24	5.4	0.74
	48	37.4	1.46
20	12	0.86	0.64
	24	2.60	0.92
	48	5.40	1.24
30	12	0.44	0.50
	24	0.84	0.94
	48	2.80	1.58

*Watts' nickel on shim stock in 1 per cent NaCl
†Values given in micrograms per square centimeter of surface area

Results

In the following, examples are given of the application of this method to various corrosive exposures, including hot-water immersion with and without access of air, intermittent salt immersion, and exposure to a drastically corrosive gaseous atmosphere. The purpose of these examples is to illustrate the applicability of the method to a variety of tests and exposures.

Hot Water Immersion Tests

The samples in all cases were 1-mil stock. The necessary number of identical samples was exposed from the outset, so each sample was used only once and discarded after analysis.

With a 10-micron Watts' nickel coating, the amounts of iron and of nickel corroded (in micrograms per sq cm surface area) were as shown in Table V.

For iron, the amount corroded increased nearly linearly with the time of exposure. The increase was not quite as regular for nickel. The well-known corrosion-accelerating effect of aeration was evident.

Replacement of some of the Watts' nickel by chloride nickel had a beneficial effect on the corrosion of iron. With the same total thickness of nickel (10 microns), but made up of 2 microns of chloride plus 8 microns of Watts' nickel, the amounts corroded in 20 hours in the absence of air were Fe = 0.04, Ni = 1.6, i. e., less iron corroded, no change in the amount of nickel corroded.

Salt Solution Immersion Tests

In intermittent immersion in 1 per cent NaCl solution, at one cycle per minute, and with the specimen inversed for half of the time in order to ensure an equal mean length of immersion for the whole specimen, the results with Watts' nickel coatings 10, 20, and 30 microns thick were as given in Table VI and in Fig. 1.

The corrosion of iron in this exposure was evidently self-accelerated. The decrease of the amount of base metal cor-

TABLE VII. RESULTS OF SULFUR DIOXIDE EXPOSURE TESTS*

Thickness of Ni (microns)	Hours of exposure	Corroded† Fe	Ni
10	6	20	660
	12	258	1560
	24	882	2220
20	6	1.3	880
	12	65.2	1760
	24	212	2340
30	6	0.2	880
	12	2.0	2020
	24	66.0	2620

*Watts' nickel on shim stock in a gaseous atmosphere over a saturated SO_2 solution

†Values given in micrograms per square centimeter of surface area

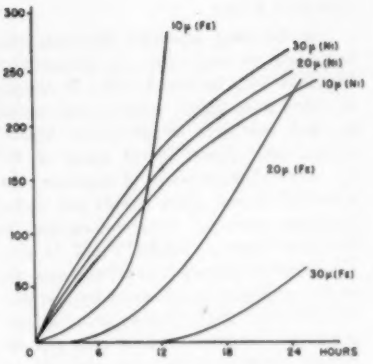


Fig. 2. Iron and nickel corrosion products (in micrograms/sq cm for iron; in 10 micrograms/sq cm for nickel), in exposure over a saturated SO_2 solution. Watts' nickel coatings, 10, 20, and 30 μ, on shim stock

roded with increasing thickness of the nickel coating was qualitative, as expected, but the analytical method permitted a quantitative representation. The amounts of nickel corroded should be practically independent of its thickness, and Fig. 1 shows this to be verified within the limits of experimental reproducibility.

Sulfur Dioxide Exposure Tests

The same samples were exposed to the drastically corrosive gaseous atmosphere over a saturated solution of sulfur dioxide in water. The results are given in Table VII and in Fig. 2. In this extremely drastic exposure, the amounts corroded were very high. Corrosion of iron was, once more, self-accelerated. Corrosion of nickel, as in intermittent immersion (Table VI, Fig. 1), tended to level off. (The slight differences between the three thicknesses of nickel are unexplained and may be due to experimental uncertainties. Evidently, the major part of the corrosion of nickel is *surface* corrosion, and only a minor fraction of it is depth corrosion resulting in baring the base metal.)

The exposures in the gaseous SO_2 atmosphere may serve as a model of the application of the corrosion-product analysis method to regular outdoor exposure tests. It will be necessary only to design the exposure racks in such a way as to ensure collection of the corrosion products and avoid their loss through washing or blowing off. On the other hand, determination of the sole corrosion products which adhere to the surface should give a direct quantitative measure of the "appearance" of the exposed samples.

Copper Undercoating Tests

Further experiments were made to elucidate the much debated question of the effect of an intermediate copper undercoating on the protective power of nickel deposited thereon. The base metal

TABLE VIII. RESULTS OF TESTS WITH COPPER AS AN UNDERCOATING

Designation of sample	Coating thickness (microns) Cu	Ni
a	6	14
b	10	10
c	2	20
d	4	20
e	0	20

Corrosion Medium	Hours of exposure	Fe Corroded (micrograms/sq cm) in samples: *a*	*b*	*c*	*d*	*e*
Intermittent	4	0	0.02	0.16	0.16	0.26
	12	0.03	0.33	0.66	0.48	0.86
immersion in	24	2.4	1.6	2.1	1.6	2.6
	48	12	19	7.4	3.5	5.4
1 per cent NaCl	72	—	—	—	14.4	10
Saturated	6	0.54	0	0.78	0.74	1.3
	12	5.0	0.56	12	6.7	65
SO_2 atmosphere	24	130	67	220	204	212
	48	640	300	560	620	400
	60	—	580	—	—	510

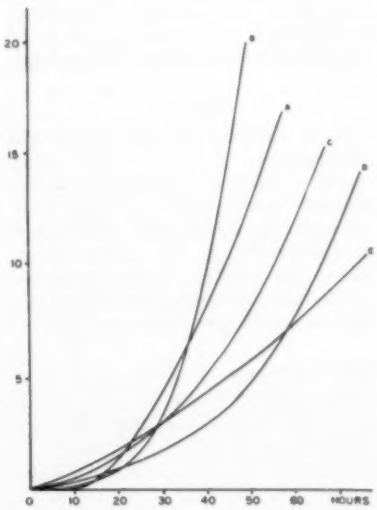


Fig. 3. Iron corrosion products (in micrograms/sq cm), in intermittent immersion in 1 per cent NaCl solution. For designation of sample, see text, Table VIII

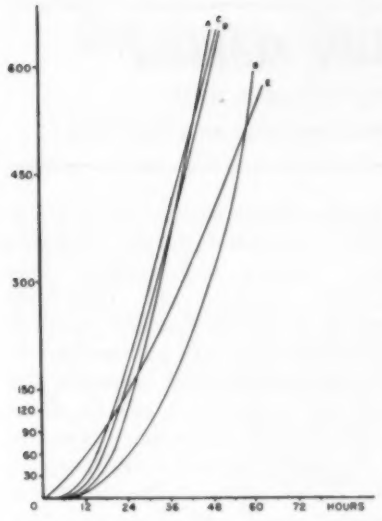


Fig. 4. Iron corrosion products (in micrograms/sq cm), in exposure over a saturated SO_2 solution. For designation of sample, see text, Table VIII

was, again, 1-mil shim stock. The amounts of iron corroded were as given in Table VIII and Figs. 3 and 4. The thin copper coatings (samples *c* and *d*) were cyanide copper; in samples *a* and *b*, the first two microns of metal were from a cyanide bath, the rest from a sulfate bath. It was evident at the initial stages of these exposures that a copper undercoating had definitely a beneficial effect. At later stages, however, the copper became a liability, the corresponding samples corroding faster than samples without copper.

The amounts of nickel corroded in these experiments varied but very little from one sample to another, irrespective of the absence or presence and the thickness of the copper undercoating. In the intermittent immersion in NaCl, at the end of 48 hours, the amounts of nickel corroded in samples *a* and *e* varied from 1.2 to 1.5 micrograms/sq cm, in good agreement with the figures of Table VI. The amounts of copper corrosion products, after 24 and 48 hours, varied from 0.40 to 0.48, and from 0.50 to 0.60, respectively, in samples *a* and *d*.

The transitory nature of the initially beneficial effect of a copper undercoating, and its detrimental effect in the long run, were further confirmed in exposure to a more mildly corrosive gaseous atmosphere, over a 1 per cent solution of sulfur dioxide in water, as shown in Table IX.

Chromium Topcoating Tests

Finally, the authors investigated cursorily, in intermittent immersion in 1 per cent NaCl, a few specimens with a thin flash of chromium over the nickel, with and without a 2 micron undercoating of cyanide copper or of electrolytic iron. The data obtained, as shown in Table X, provided a numerical measure of the well-known excellent protection-enhancing effect of a thin chromium flash. At the same time, they showed, once more, that the effect of a copper undercoating was beneficial only at the earliest stages, and became harmful at later stages of the exposure. Even more disappointing was the effect of an undercoating of electrolytic iron which, in this combination and in this test, was beneficial—if at all—only at the very earliest stages. Specimen *e*, with a thick 15-micron chromium coating directly on iron, was included at a specific request to investigate the corrosion resistance of this nickel-saving combination. As far as the authors' results go, such a nickel-free combination appears to be worthless.

TABLE IX. RESULTS OF EXPOSURE TESTS IN GASEOUS ATMOSPHERE OVER 1 PER CENT SOLUTION OF SO_2

Designation of sample	Coating thickness (microns) Cu	Ni
a	10	14
b	2	20
c	4	20
d	—	20

Hours of exposure	Fe corroded (micrograms/sq cm) in sample: *a*	*b*	*c*	*d*
6	0	0	0	0.06
12	0.04	0.08	0.08	0.72
24	5.6	12.8	8.0	12.0
48	136	168	120	80

Conclusions

The authors do not claim that the above illustrative results of the application of the corrosion-product analysis method supply conclusive answers to such controversial and delicate points as effects of intermediate undercoatings. Rather, they are meant to point the way whereby answers can, through further extensive systematically thorough work, be obtained in an objective fashion and in meaningful numerical language. It is believed that the method adds to the immense research that has been and is being conducted on the corrosion-inhibiting power of electrodeposits, a procedure apt to yield clearcut answers, and it is hoped that this tool will be adopted and used in further research.

TABLE X. RESULTS OF TESTS WITH A CHROMIUM FLASH TOP COATING*

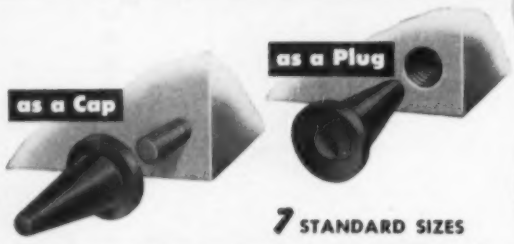
Designation of sample	Thickness of coating (microns) Fe	Cu	Ni	Cr
a	—	—	20	0.5
b	2	—	20	0.5
c	—	2	20	0.5
d	—	—	20	—
e	—	—	0	15

Hours of exposure	Fe corroded in sample† *a*	*b*	*c*	*d*	*e*
8	—	—	—	—	18
12	0.08	0.04	0.02	0.86	74
20	—	—	—	—	920
24	0.46	0.6	0.26	2.6	—
48	1.3	1.5	1.8	5.4	—
72	—	—	—	10	—
96	3.6	4.4	6.0	—	—

*Intermittent immersion in 1 per cent NaCl solution
†Values given in micrograms per square centimeter of surface area

For Metal Finishers!

Pressure Moulded NEOPRENE **"CAPLUGS"**



7 STANDARD SIZES

	A	B	C	D	E	F	G
TO PLUG HOLE SIZE	1/8-3/16	3/16-1/4	1/4-5/16	5/16-1/2	1/2-5/8	9/16-11/16	5/8-3/4
TO CAP STUD SIZE	3/32-5/32	5/32-3/16	3/16-1/4	1/4-5/16	5/16-3/8	3/8-7/16	5/16-1/2

MASKING PROBLEMS OUR SPECIALTY!

WRITE FOR **FREE** SAMPLE KIT...

DUGGAN *Masking Devices*

2030 WEST FORT STREET
DETROIT 16, MICHIGAN

USE READER SERVICE CARD; INDICATE A 1037.

WHAT TYPE OF BUFF? WHAT DIAMETER? WHAT SPINDLE SPEED? WHAT SURFACE SPEED?

FREE!
AMAZING NEW
POCKET CALCULATOR
ANSWERS ALL YOUR BUFFING QUESTIONS
EASY AS A-B-C!

WANT TO KNOW the right buff the right size, the right speed — for every buffing job? No need to guess or figure — just slip the pointer along this handy pocket slide rule and read your answer in a jiffy! Ideal buffing guide for shop foremen or plant superintendents. Compact, handy, durable — fits in coat or shirt pocket.

DEPT. P

American Buff Company
2414 S. LA SALLE STREET • CHICAGO 16, ILLINOIS
"For the Job that's Tough, Use an American Buff"

YOURS... ABSOLUTELY **FREE!** WRITE TODAY ON COMPANY LETTERHEAD

USE READER SERVICE CARD; INDICATE A 1038.

Book Review

DR. HAROLD J. READ

Professor of Metallurgy, Pennsylvania State College

PROTECTION AND ELECTRODEPOSITION OF METALS, Vol. 3, 350 pages, 1951. Published by Her Majesty's Stationery Office, London, and available from British Information Services, 30 Rockefeller Plaza, New York 20, N. Y. Price, $6.75, postpaid.

This book is a collection of reports, gathered by the British Department of Scientific and Industrial Research, of research work carried out under the direction of British governmental and military agencies. The character of the work presented herein is essentially practical, that is, few of the studies are of fundamental or theoretical nature. All of the investigations are, however, fully reported and give evidence for the most part of careful planning and comprehensive execution.

The 33 reports are divided into two main groups, the first of which is concerned with the protection of metals by surface treatments, and the majority of the articles deals with treatments for the alloys of aluminum and magnesium. Chromate baths for the finishing of magnesium alloys receive a great deal of attention in papers dealing with every aspect of the processes, including hot, cold and electrolytic baths, pretreatments, control, testing and the rejuvenation of used baths. The control and operation of anodizing baths for aluminum alloys and particularly the corrosion testing of the finished work from both sulfuric acid and chromic acid solutions are discussed in several reports. Ferrous materials receive but scant attention, although a brief note on a bright dip for steel is interesting. The techniques for using lanolin and its efficacy for protection of steel against outdoor exposure are evaluated on the basis of quantitative data.

The second and smaller group of papers, dealing purportedly with electrodeposition of metals, is devoted almost exclusively to reports on some problems of control and testing, particularly chemical analyses. Those which do not fall in these categories have nothing to do with electrodeposition, e.g., a report on the protective value of selenium coatings applied to magnesium alloys by a dry technique. The analytical papers deal with problems encountered in working with cyanide-zinc, chromium and nickel plating baths. Thickness tests receive some attention, specifically the A.R.D. magnetic apparatus and two chemical tests for cadmium coatings. A particularly interesting report concerns the evaluation of the B.N.F. adhesion test and of equipment for conducting the test.

The book has been well edited for uniformity of style and it is nicely printed. American readers may encounter some difficulty with the numerous references to British specifications, and they should remember the pitfall of the Imperial gallon.

Get extra dividends from your cadmium plating

...with DU PONT "CADALYTE" PLATING SALTS AND "CADALYTE" BRIGHTENER

YOU CAN be sure of extra returns for every plating dollar with Du Pont "Cadalyte"—the *complete* cadmium plating salt. "Cadalyte" contains all the chemicals needed for an efficient plating bath . . . simplifies production over a wide range of operating conditions.

Easily operated and maintained, the "Cadalyte" bath has excellent throwing power and high cathode efficiency. Lustrous uniform deposits are obtained directly from the bath at high current densities. You can make a fresh solution by simply dissolving "Cadalyte" in water . . . or use "Cadalyte" for replenishing the metal content of existing baths.

"CADALYTE" BRIGHTENER maintains the high covering power of the bath at its peak . . . assures brilliance and uniformity of deposits. It may be added separately or with sodium cyanide in "Cadalyte" Maintenance Compound.

We can supply your cadmium anode requirements from conveniently located stock points in 11 principal cities. For complete information—including practical plating advice and descriptive literature on Du Pont plating chemicals—contact our nearest district office, or send in the coupon below.

DISTRICT OFFICES:
Boston . Charlotte . Chicago . Cincinnati . Cleveland . Detroit
El Monte (Calif.) . Kansas City* . New York . Philadelphia
*Barada & Page, Inc.

Chemicals · Processes · Service
for **ELECTROPLATING**

DU PONT
REG. U.S. PAT. OFF.

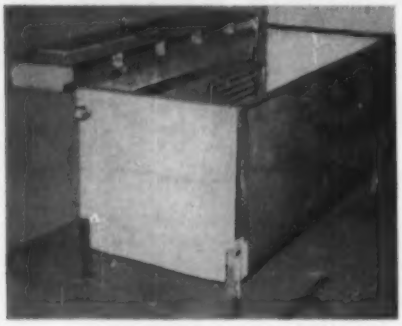
BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

E. I. du Pont de Nemours & Co. (Inc.) P-93
Electrochemicals Dept., Wilmington 98, Del.

Please send me complete information on Du Pont Plating Chemicals—properties, advantages and recommended procedures. I am interested in the following types of plating:

☐ Cadmium Plating ☐ Tin Plating
☐ Copper Plating ☐ Zinc Plating

*Name*_____ *Position*_____
*Firm*_____
*Street & No.*_____
*City*_____ *State*_____



Short-cuts to better plating production

welded by STORTS

ON PLAIN TANKS, lined tanks, exhaust systems and accessory equipment, customer experience has proved that Storts high quality fabrication consistently results in better performance and longer service life—with no interruptions to production.

42 STONE STREET — STORTS WELDING COMPANY INCORPORATED — MERIDEN, CONN.

Manufacturers of Welded Fabrications to Specification

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1040.

CrO_3 Chromic Acid for

DECORATIVE PLATING
HARD CHROMIUM PLATE
ANODIZING ALUMINUM
CHEMICAL CONVERSION COATINGS
STRIPPING COPPER
METAL CLEANING BATHS
ORGANIC SYNTHESIS
MANUFACTURE OF CATALYSTS

The Mutual name and trade mark on a Chromic Acid drum guarantee a product with a minimum assay of 99.75% and a sulfate content not exceeding 0.1%. Chromic Acid of that purity may be used with confidence in any of the applications shown here.

SINCE 1845

MUTUAL CHEMICAL COMPANY OF AMERICA

270 MADISON AVENUE • NEW YORK 16 N. Y.

Equipment and Supplies

E—918. New Screen Separator—Latest addition to a line of industrial equipment is the new Rampe Screen Separator.

This medium size separator is built to use a standard 24-inch diameter foundry riddle. It is operated by a ball bearing

a-c motor through a novel design nylon eccentric bushing. The stroke of the screen movement is readily adjustable from 0–1½ inch by loosening and tightening one bolt.

For complete information write the manufacturer, Rampe Manufacturing Co., 3320P St. Clair Ave., Cleveland 14, Ohio, or use Reader Service Card.

E—919. New Heavy-Duty Cleaner for Iron and Steel—Oakite Products, Inc., have announced the development of a new detergent, Composition No. 26, designed to remove extra-heavy soils from iron and steel in one operation, thus eliminating the need for separate precleaning and alkaline cleaning procedures.

The material combines the heavy-duty cleaning action of both alkaline and solvent-type cleaners and also contains surface active agents, a combination which is highly effective in removing tenacious soils. Among the advantages claimed for Oakite No. 26 are the following: (1) quick penetration of soils that reduces cleaning time; (2) thorough soils removal; (3) good rinsing action—no insoluble or oily films left on surfaces to interfere with painting or plating; (4) simplicity in use—heavy soils are removed in a single immersion; (5) economy—one-step cleaning procedure saves cleaning time and materials.

Additional information concerning this cleaner is available to readers. Write to Oakite Products, Inc., 140 Rector St., New York 6, N. Y., or use Reader Service Card.

E—920. Turntable Design Washing Machine—A newly designed washing machine, offered by G. S. Blakeslee & Co.,

Available for Immediate Shipment, Attractive Values

THE FOLLOWING EXCELLENT REBUILT AND GUARANTEED ELECTROPLATING MOTOR GENERATOR SETS AND RECTIFIERS, WITH FULL CONTROL EQUIPMENT:

PLATERS

1—7500/3750 AMPERE, 6/12 VOLT, MUNNING "OPTIMUS."
1—6000/3000 AMPERE, 6/12 VOLT, BOGUE.
1—5000/2500 AMPERE, 8/16 VOLT, ELECTRIC PRODUCTS, 25° C.
1—5000/2500 AMPERE, 9/18 VOLT, COLUMBIA.
1—5000/2500 AMPERE, 6/12 VOLT, EAGER.
1—5000/2500 AMPERE, 6/12 VOLT, CHANDEYSSON, 25° C.
1—4000/2000 AMPERE, 6/12 VOLT, CHANDEYSSON.
1—3000/1500 AMPERE, 6/12 VOLT, COLUMBIA, Synchronous
1—2000/1000 AMPERE, 8/16 VOLT, ELECTRIC PRODUCTS.
1—2000/1000 AMPERE, 6/12 VOLT, CHANDEYSSON.
1—2000/1000 AMPERE, 6/12 VOLT, MUNNING "OPTIMUS."

ANODIZERS

1—4000 AMPERE, 40 VOLT, CHANDEYSSON, Exciter-in-head.
2—1000 AMPERE, 30 VOLT, IDEAL, Exciter-in-head.
1—1000 AMPERE, 40 VOLT, CHANDEYSSON, 25° C.
1—400 AMPERE, 40 VOLT, M. G. C., Exciter-in-head.

RECTIFIERS

2—BRAND NEW BASIC RECTIFIERS, 1500/750 amperes, 6/12 volts. Special Price: $750.00 each. Separate Voltage Controls Available.
1—2000 AMPERE, 6 VOLT, G. E. COPPER OXIDE RECTIFIER.
1—GREEN SELECTOPLATER, 1800 AMPERE, 12 VOLT.
1—UDYLITE-MALLORY, 1500/750 AMPERE, 6/12 VOLT.

BUFFING LATHES

3 HP, 5 HP, 7½ HP and 10 HP, DIVINE, HAMMOND, M. G. C., GARDNER, TWIN 5 HP and TWIN 7½ HP ROME, and other popular makes.

SPECIAL

1—MERCIL 12 x 12 CENTRIFUGAL DRYER, Electric Heat.
4—24" and 30" ROBBINS & MYERS 2-SPEED VENTILATING FANS.
2—DIVINE & PORTER CABLE BACK STAND IDLERS.

Above is partial list only. Write to us for all your requirements for Plating, Anodizing and Metal Finishing

WIRE—PHONE—WRITE

M. E. BAKER CO.
25 WHEELER STREET
Kirkland 7-5460 CAMBRIDGE 38, MASS.

incorporates several interesting features resulting in economy of space and economy in operation. Machine work either in baskets or in special fixtures rides a turntable. That means great saving in space and operating personnel. The turntable brings clean parts back to the man who put the work in the machine. High efficiency in operation is due to the turntable taking the work through a spray for washing and rinsing. It also takes the work through the air blow-off section, and then back to the loading-unloading station. For more information on this equipment use Reader Service Card.

E—921. New Buffing Compound Applicator—A new air-operated buffing compound applicator that features a variable number of applications per minute is announced by the George L. Nankervis Company of Detroit, Mich. Designated as the "600" Series, the new applicator is available in four models to accommodate rectangular or round compound bars.

It can be installed on all types of buffing machines from simple lathes to multi-operation automatics of light weight construction. Less than 18 pounds, it permits installation on floating heads without disturbing balance and can be installed in any position without affecting operation.

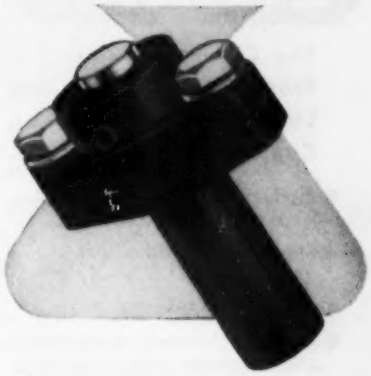
Savings in buffing costs up to 40 per cent have been reported by users of the new applicator through increased buff life, compound savings, and reduction in labor. For more information on this product, use Reader Service Card.

E—922. Safety Solvents—A new series of safety solvents for cleaning greasy, oily, dirty machine parts has been recently developed, and is being manufactured and nationally distributed by Harco Chemical Co., Cranford, N. J. Developed primarily to replace toxic carbon tetrachloride, the Harco series present a wide spread selection with flash points ranging from 140° F to 280° F.

Any of the series are recommended for degreasing and cleaning of electrical equipment and all metal parts. They dry fast, leaving no deposit.

Du-Lite

"Gives our tools Sales Appeal"



BARNABY MFG. CO. of Bridgeport, Conn., reports: "Our close proximity to salt water has given us problems in rust prevention for many years. We have experimented with many black oxide finishes but none has proven as successful, safe, and inexpensive as DU-LITE—our tools have better sales appeal—our volume has been on the increase ever since we started using this modern, progressive oxide finish."

Depend on Du-Lite, the metal-finishing specialists, for the most efficient and economical cleaners, black oxide finishes and phosphate coatings. Write for full details on:

Du-Lite Black Oxide for Steel.
3-0 Black Oxide for stainless steel and malleable iron.
SD Compound for removing occluded salts.
Phosteel and Phospray for phosphatizing steel, iron or zinc.
Du-Lite Non-Acid Black Oxide for copper and copper alloys.
Dynakleen for bright cleaning all metals.
Kwikseal and Proctoil water displacing oils.

Or send us samples of parts and we will process them for your approval.

DU-LITE CHEMICAL CORP.
MIDDLETOWN, CONN.
Send more information on Du-Lite..... ☐
Send information on metal finishing products.. ☐
Have your representative call..... ☐

Name.....
Company.....
Address.....
City..... Zone..... State.....

Du-Lite
METAL FINISHING SPECIALISTS

Consider
these outstanding features of
New Luster-on®
COBRA*

The Chromate Finish For Producing Inhibited and Lustrous Finishes on Copper, Brass or Bronze.

- Produces a permanent lustrous finish even in recessed areas.
- Stands over 100 hours standard salt spray
- Assures very long life
- Can be handled immediately after treatment cycle — no staining or finger marks
- Replenishment required only to replace dragout
- Exhaust of bath in use is optional — not required
- Excellent paint bond qualities

Specify
New Luster-on®
COBRA
for

- Inhibited and lustrous finishes on copper, brass or bronze
- Use on solid or plated copper or brass
- Cleaning and deoxidizing copper and brass parts
- Removing flux on soldered parts

Luster-on — the first in the field and still the leader

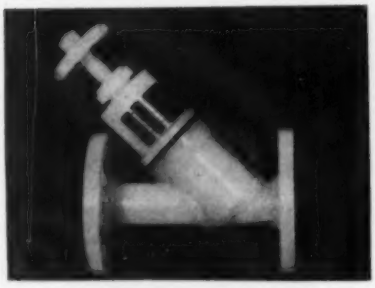
Write for full data sheets and send a part for free processing

*Patent applied for

THE Chemical CORPORATION
87 Waltham Ave., Springfield 9, Mass.

For more information on these solvents write to Harco Chemical Co., 338P North Ave. E, Cranford, N. J., or use Reader Service Card.

E—923. Corrosion Resistant Plastic Valves—The Vanton Pump Corporation, Empire State Building, New York City, announced the availability of a new line of corrosion resistant plastic globe and "Y" valves. Constructed entirely of



polyethylene, except for the sealing diaphragm on the disc which is composed of a polyethlene-polyisobutylene mixture to insure maximum resilience and drop tightness, these valves will withstand the corrosive action of most acids, including sulfuric, hydrochloric, nitric and hydrofluoric, as well as a variety of caustic solutions.

Relatively light in weight, but high in strength, the valves are recommended for working pressures up to 50 psi and temperatures to 150° F. For more information use Reader Service Card.

E—924. Detrex 63—A new metal cleaner, specially formulated for use in the vitreous enameling industry, has been developed by the Detrex Corporation of Detroit. Described as a medium-high alkaline compound containing very high wetting and penetrating properties, the new cleaner has been trade-named Detrex 63.

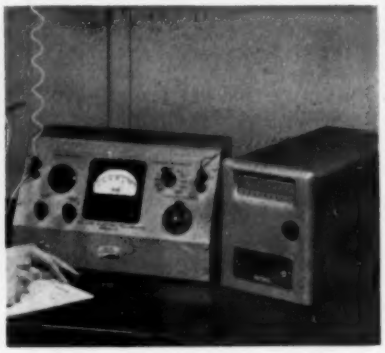
One of its most outstanding assets according to Detrex officials, is its exceptional ability to emulsify large quantities of mineral oils and greases and keep them in a state of suspension.

Sales of the new metal cleaner will be handled by the newly organized Enameling Section of Detrex's Chemical Processing Division headed by William H. Webb, managing consultant. For additional information on this product, use Reader Service Card.

E—925. Alk-A-Sol—A new, powerful paint stripper is now being manufactured and sold under the trade mark Alk-A-Sol for the rapid removal of paint and synthetic resin coatings from production parts and work hangers.

The material was developed by the Whitfield Chemical Company, Dept. 23-B 14225 Schaefer Highway, Detroit 27, Mich.

WE CUT OUR OWN ANALYSIS TIME BY MORE THAN 50%
right in our home plant!



We do a great deal of electro-plating at the Patent Button Company—not only on our own products, but also on contracts for many other firms—much of it to strict Government specifications. We plate with copper and zinc cyanide, cadmium, brass and nickel solutions.

Analyses in 20 Minutes!

Before we developed the Patwin C-1 Electro-Polarizer, we spent an average of 60 minutes in analyzing a typical solution by chemical methods. Now, with this instrument, analyses of very high accuracy are completed in 15-20 minutes! Our production has been speeded considerably, and we want to pass the news along to other electro-platers facing the same problem.

Top Quality! Low Cost!

The Patwin C-1 Electro-Polarizer needs only a standard 110 A/C outlet—comes in a steel case which takes up only 6 square feet of bench space—incorporates the finest components we're able to lay our hands on (the galvanometer, for instance, is GE's high sensitivity portable model)—and costs about $100 less than any other polarographic instrument we've ever heard of!

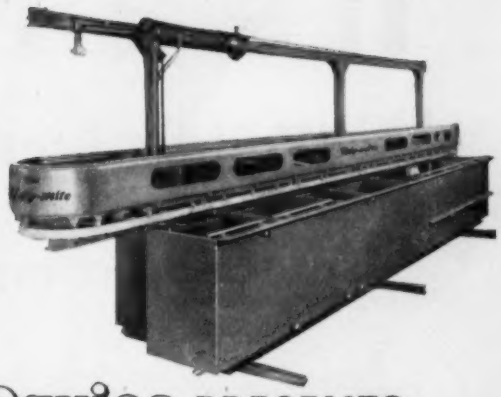
The Patent Button Company

PATWIN INSTRUMENTS Division
THE PATENT BUTTON COMPANY, Waterbury 20, Conn.

Please send me more information about your Patwin C-1 Electro-Polarizer.

NAME_____
FIRM_____
ADDRESS_____
CITY_____ STATE_____

NEED
LOW COST
AUTOMATIC
PLATING?



Davies PRESENTS

THE NEW UDY-MITE by *Udylite*

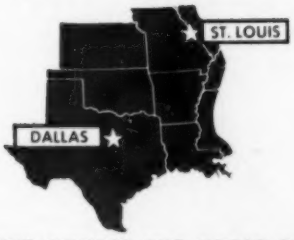
for only $6450

Built to replace small, hand operated tanks, the UDY-MITE delivers high production automatically and economically, yet does not require the constant attention of experienced platers.

- **Fully automatic**
- **12 stations**
- **Easily moved within plant**
- **Handles 12" x 6" x 24" racks**
- **Rate 100 racks per hour**
- **Perfect uniformity of product**

WRITE TODAY FOR COMPLETE DETAILS

LET Davies SERVE YOU



OUR SERVICE COVERS THE GREAT SOUTHWEST

Davies is southwestern sales and service representative for the "blue ribbon" firms of the plating and polishing industry.

- THE UDYLITE CORPORATION
- FREDERICK B. STEVENS, INC.
- MacDERMID, INC.
- ALLIED RESEARCH PRODUCTS (Iridite)
- ALMCO DIVISION, QUEEN STOVE WORKS
- METALWASH MACHINERY CORPORATION
- INDUSTRIAL ELECTROPLATING CO. (Niehaus Fume Separators)
- R. O. HULL AND COMPANY
- CIRCO EQUIPMENT COMPANY
- ALROSE CHEMICAL COMPANY (Jetal Process)

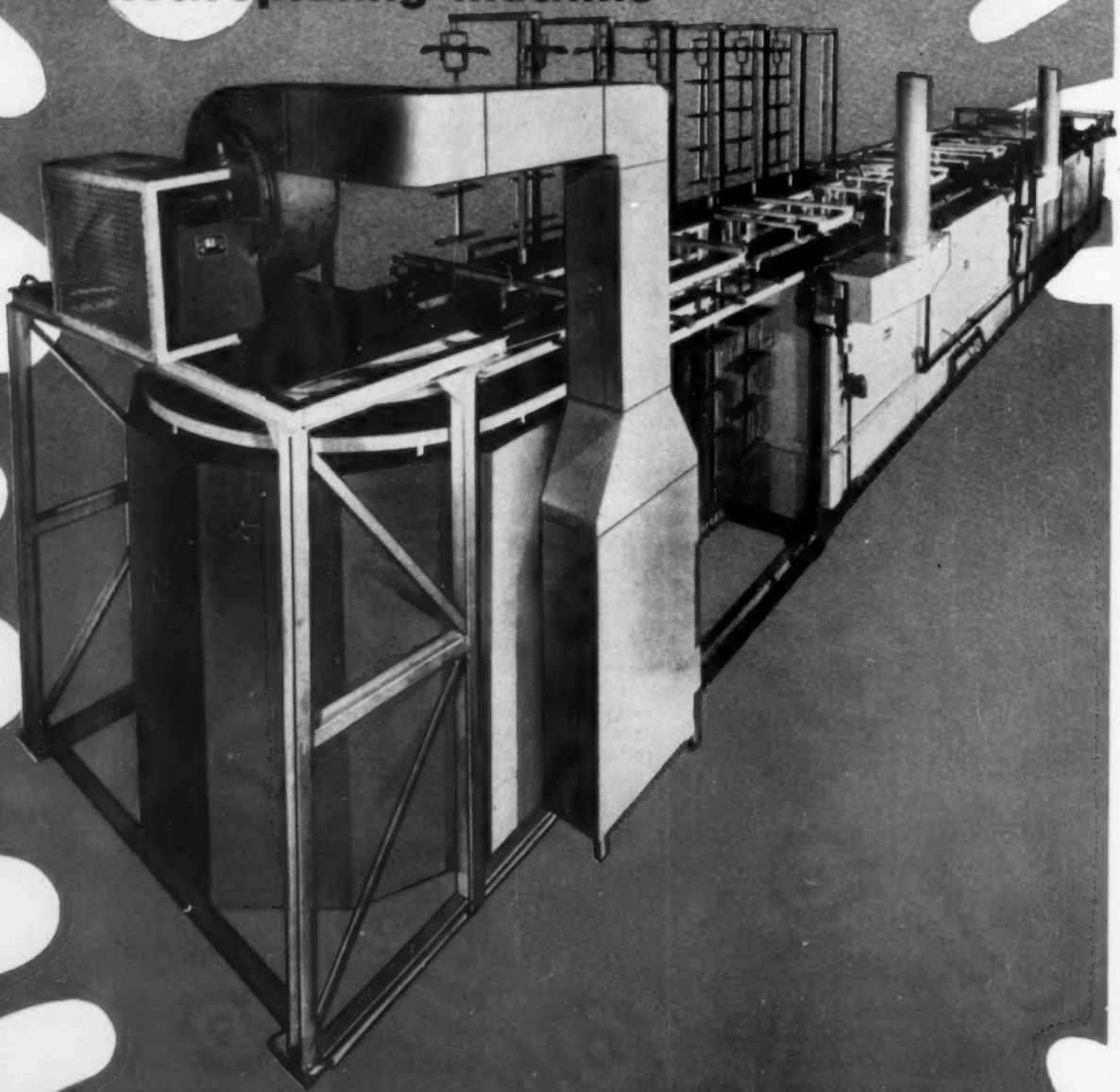
—and many others

depend on
DAVIES
the Southwest's leading supplier
of industrial plating and polishing
• EQUIPMENT
• MATERIALS
• KNOW-HOW
Davies
Supply & Manufacturing Co.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1046.

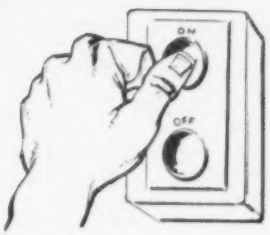
It's a Revolution in

Wagner Brothers fully automatic electroplating machine



Plating Automation

A complete new approach to automation in plating—



Fully Engineered-
Proven Principles-
Now in Plating Production

CUTS LABOR — You load it and press the button — your Wagner does the rest.

CUTS DOWNTIME — All working parts are readily accessible for servicing — Built in sections for quick inspection and service without disturbing work or other sections.

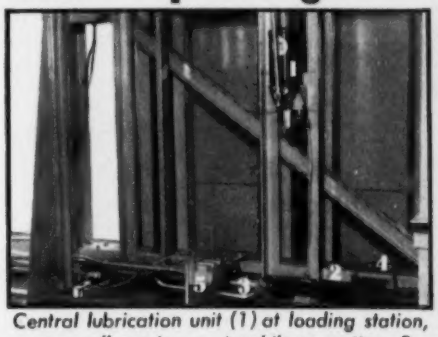
CUTS POWER NEEDS A Wagner Fully Automatic operates on *one* motor of less than half the power needed for any other electroplating equipment of comparable capacity.

CUTS CONTAMINATION—No grease-loaded mechanisms are located above your tanks, eliminating a major plating problem.

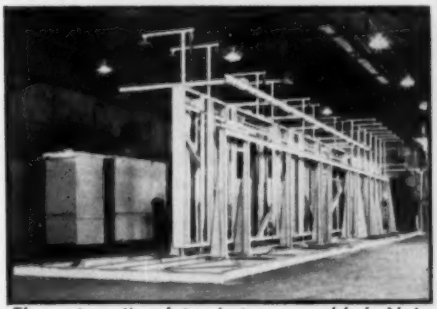
CUTS SPACE NEEDS — Your Wagner Fully Automatic takes less floor space — less ceiling height. For example, it will handle a 48" rack under a *12-foot ceiling.*

AND DOZENS OF OTHER cost cutting features. It's all new — It's fully proven — It's in production. It's Wagner Brothers Brand New Fully Automatic Plater.

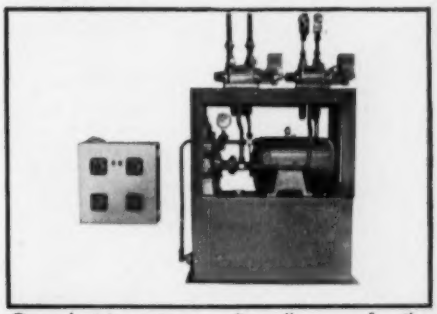
Wire your nearest Wagner representative or call direct at once and get complete information on this revolutionary and efficient New Approach to electroplating automation.



Central lubrication unit (1) at loading station, greases all moving parts while operating. Reciprocating carriage (2) is actuated by simple trouble-free cylinder (3). Decelerating cams (4) operate control valve (5) to assure smooth, long life operation.



The automatic plater being assembled. Note that all lubricated machinery is centrally located—not over tanks—for easy servicing and to preclude contamination of fluid in tanks. This unit is in three sections for economical transportation.



One electric motor supplies all power for the hydraulically driven automatic plater. The power unit and control panel can be installed at any convenient point in the plant for convenience in installation, servicing and operation.

Wagner **BROTHERS, INC.**

425 MIDLAND AVE. • DETROIT 3, MICH.

CHICAGO • ROCHESTER • CLEVELAND • CINCINNATI • INDIANAPOLIS

Equipment and Supplies

Used for quick removal of organic resin and pigmented coatings from steel, zinc, and magnesium alloys, Alk-A-Sol was especially developed for removing baked enamels, varnishes, and lacquers containing melamine, alkyd, methacrylate, polyamide, ureaformaldehyde, phenolformaldehyde, and Epon resins. For additional information on this product use Reader Service Card.

E—926. Compact Vapor Degreaser—A new compact combination vapor degreasing unit is being produced by Phillips Manufacturing Co., 3565 W. Touhy Ave., Chicago 45, Ill. The new unit is capable of performing 200 pounds of work per hour either in baskets or as individual pieces.

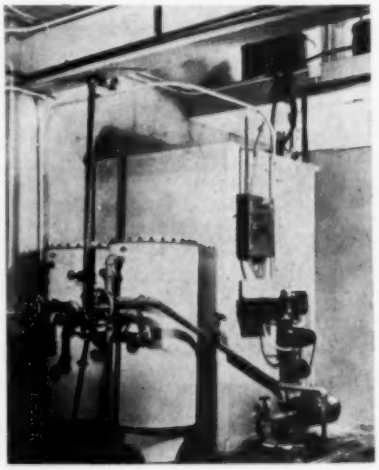
The new unit, electrically heated and designated the No. 100 CS, incorporates cool rinse, hot rinse and vapor degreasing. Distilled solvent is collected by means of a condensate return trough, passed through a water separator and returned to the rinse sump. The boiling sump is fed by over flow from the rinse sump.

For additional descriptive data on this equipment use Reader Service Card.

E—927. Vacuum Coater—National Research Corporation, 70P Memorial Drive, Cambridge, Mass., announces the Model 3111 Coater for development work and limited commercial production in vacuum metallizing. Although the vacuum evaporation of metals to provide metallic finishes on plastics, metals, fabrics, and glass has been established as a commercial process over the past ten years, process equipment has been limited generally either to laboratory apparatus or to large production units. Vacuum coating equipment has not been available previously for the transitional stage between experimental work in the laboratory and full-scale commercial production. The Model 3111 Coater bridges this gap and is designed for pilot and limited production.

For additional information on this equipment use Reader Service Card.

E—928. Package Water Conditioner—Engineered to a high degree of efficiency and simplicity is the completely integrated Permutit package water conditioning plant designed by the Permutit Company, 330 W. 42nd St., New York 36, N. Y.



These units, without any alterations, may be used: (1) to remove turbidity, color and organic matter from water supplies; (2) to chlorinate; (3) to remove bad tastes and odors; (4) to remove iron and manganese; (5) to neutralize; (6) to soften and (7) to de-alkalize. For additional information on these units use Reader Service Card.

E—929. New Compound Replaces Hydrofluoric Acid—Enthone, Inc., 442 P. Elm St., New Haven, Conn., have announced a new powdered product called "Actane 33" which, in many cases, will replace hydrofluoric acid. Because of the powdered nature of the product, there are less hazards in handling it than with liquid hydrofluoric acid which can produce serious burns. Actane 33 has many uses. It can be used in combination with sulfuric acid to remove silica, sand and scale from steel. It can be used with nitric acid and ferric sulfate for pickling of stainless steel. It is used with sulfuric acid for etching of aluminum and with nitric acid to produce mixtures that remove silicon and copper from aluminum to produce white

Here's a unique type of batch cleaning machine for all kinds of metal parts that enables you to fit the cleaning operation right into your production line. The cleaning job is so speeded up by the "up and down" motion of the work in the machine that in most cases the flow of parts through the machine is practically continuous from a production line viewpoint.

No Motors...No Gears...No Sprays

This Magnus Aja-Lif Cleaning Machine has NO motors... NO gears... NO sprays. It is powered by compressed air. Its compactness makes it easy to fit into limited floor space, and as there are no overhead conveyors or hoists, there is no head-room difficulty.

The Magnus Aja-Lif Cleaning Machine is fast and uniquely thorough in its cleaning action because the work itself moves up and down in the cleaning solution many times a minute, providing a mechanical "shearing" action on the dirt and chips, plus constantly agitated cleaning solution that works faster and better because of it.

Minimum Labor Costs

The Aja-Lif Machine loads and unloads at the top, at waist level. One lever lowers the load, starts the machine, cuts it off and raises the load at the end of the brief cleaning period. It's a one man job, with no supervision required during cleaning.

WRITE FOR BULLETIN 703-AL

magnus

MAGNUS CHEMICAL CO., INC.
41 South Avenue, Garwood, N. J.
In Canada—Magnus Chemicals, Ltd., Montreal
Service Representatives in Principal Cities

clean surfaces. Actane 33 is recommended for use in acid pickles in plating cycles to remove siliceous films.

The product contains soluble fluorides and penetrating and dispersing agents. For additional information on this new material, use Reader Service Card.

E—930. CD Strip 100—A new fast drying, tough, strippable coating has just been developed by Chemical Development Corporation, Danvers, Mass. Called CD Strip 100, it is supplied as a solvent solution and is easily applied by dipping, brushing, or spraying. It is water insoluble and extremely strong even in thin gauges.

It can be removed easily, when desired, by stripping or peeling back the entire coating in one piece. It is bright red in color so that the operator can quickly determine what sections have been treated. CD Strip 100 can also be used in place of masking tape to protect certain areas during painting. Another interesting use is for application to spray booths. The interior of the booth is coated with CD Strip 100. Excess paints and enamels from regular painting operations will build up on the original coating and can be peeled off in large slabs or selections when desired.

For more information on this new material use Reader Service Card.

E—931. New Rubber and Plastic Materials—Three new rubber and plastic materials for chemical, electrical and mechanical applications have been developed recently by the American Hard Rubber Company and are called Ace-Flex, Ace-Riviclor and Dur-Ace.

Ace-Flex is a tough, flexible, lightweight plastic material with good electrical properties and outstanding chemical resistance. It is non-toxic and can be steam sterilized. It is available as flexible tubing and sheet.

Riviclor is an unplasticized thermoplastic with exceptional chemical resistance, high impact strength and good fabricating characteristics. It is one of the most chemical resistant thermoplastic materials.

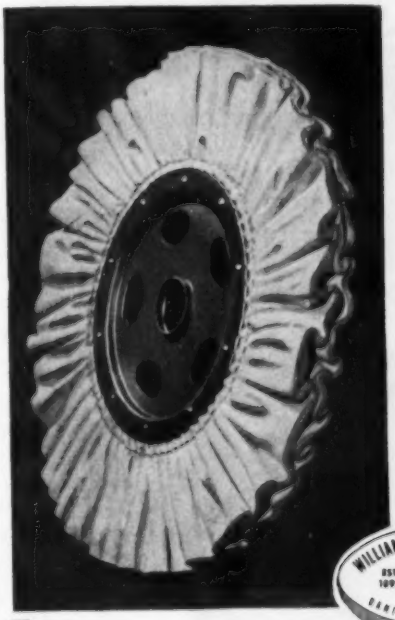
Dur-Ace is a new thermoplastic, multipolymer material with high impact strength, excellent dimensional stability and good chemical resistance. Further details on these materials are available. Use Reader Service Card.

E—932. Improved Abrasive Belt Splicer—Improvements and changes in the Econaway abrasive belt splicer, designed to increase the speed of splicing abrasive belts, improve the quality of splice, save shop bench space and allow a still larger saving in the cost of abrasive belts, are announced by Aget-Detroit Company, Ann Arbor, Mich.

The improvements include: an enclosure for the motor, the belt drive and the arbor which carries the grinding wheel; cutter and press bars are now mounted on top of the enclosure so that the operator can perform the various steps in splicing any grit paper or cloth backed abrasive belts without moving from one station to another; and electrical curing press to reduce the curing time from 24 hours to less than 60 seconds. Thus, abrasive belts may now be spliced even while a sanding machine waits, and the newly spliced belt can be put into service instantly. For more information on this new product use Reader Service Card.

E—933. New Wheelbrush—A wheelbrush of new design which provides longer brush life, improved performance, increased maximum wheel speeds, insured balance and extra safety at no increase in cost, is now being produced by the Industrial Division of the Fuller Brush Company. The tool can be used either singly or in multiple units in any of the many industrial applications where wheelbrushes are adaptable.

Features of the wheelbrush, called Fullanchor, stem from the new design. As the trim wears down, larger sideplates can be exchanged easily for smaller ones, thus exposing a new length of trim and greatly increasing the life of the brush. Brush balance is achieved by clamping an almost identical number of filaments in each tuft, then anchoring each tuft to the core with evenly spaced heavy wire staples driven through a continuous steel channel. This uniformity of fill keeps Fullanchor brushes to a closer balancing tolerance than government standards require. For more information on these new brushes use Reader Service Card.



Take a Good Look at

Williamsville's NEW

CUTMASTER

for Automatic Buffing!

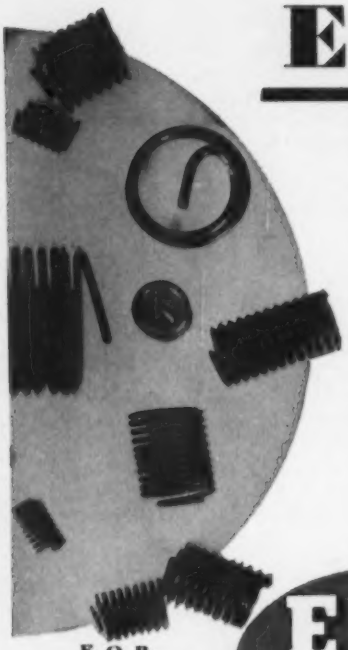
WILLIAMSVILLE BUFF DIVISION EST 1893 A1 DANIELSON CONNECTICUT

Cut on the bias for long, rugged service
Steel center is perforated for cool running
Engineered throughout for perfect balance

Let us rush you full details of how the new CUTMASTER can cut your automatic buffing costs now—write, wire or phone!

WILLIAMSVILLE BUFF DIVISION
The Bullard Clark Company
DANIELSON, CONNECTICUT

Estox



Perma Black Process

18-8 stainless steel springs blackened to government specifications in addition to all other ferrous metals

Operating costs reduced **40%**

F. O. B. New Haven, Detroit

Estox
TRADE MARK REGISTERED
PRODUCTS

Perma Black Metal Cleaners Brazing Flux | Soluble Oil Additives

STANDARD RESEARCH, INC.
462B Grand Avenue, New Haven, Connecticut

USE READER SERVICE CARD; INDICATE A 1050.

Stop costly shut-downs and heavy repair bills caused by dirt, rust or scale carried in pipe lines to regulators, traps, pumps, meters, burners, etc.

USE Sarco strainers also to remove impurities from any fluid end product.

Sizes ¼" to 8", for any commercial pressure.

Write for new Bulletin 1202 514

SARCO SAVES STEAM

SARCO COMPANY, INC.
Empire State Bldg., New York 1, N.Y.
SARCO CANADA LTD. TORONTO 2, ONTARIO

Article Abstracts

No copies of articles are available at the offices of "Plating". Photostats may be had from libraries having files of the journal in question and offering photostat service, usually at 30-50 cents a page. Ask your public library to consult the Union List for names of libraries having the particular journal. Abbreviations used are those of Chemical Abstracts.

Preece Test for Galvanized Coatings H. Bablik, F. Götzl and E. Nell, Metalloberfläche A66 (May, 1953).

The usefulness of this test is criticized because various alloy phases are attacked at different rates (eta phase: 60–80 g/sq m, zeta phase: 30 g/sq m, delta-1 phase: 20 g/sq m, per one minute dip). Furthermore, cracks and surface oxide layers influence the rate of attack. Foreign metals, except tin, exert only a small influence on the rate of attack.—Otto Kardos.

Gold Plating. B. Wullhorst, O. Loebich, R. Springer, Metalloberfläche A49 (April, 1953), B58 (April, 1953), and A61 (April, 1953), A76 (May, 1953), respectively.

Detailed reports on electrodeposition of gold and gold alloys and about gold diffusion alloys are given. Springer gives an extensive bibliography and patent survey.

Special processes are mentioned which use short (e. g., 0.4 second) direct current impulses of different voltage (e. g., 0.5–2.2–10 volts corresponding to 0.2–0.8–4.8 amp/sq dm) in regular sequence. This results in the deposition of relatively very hard Au-Cu-Ni alloys of controllable composition.—Otto Kardos.

Ionic Current and Film Growth of Thin Oxide Layers on Aluminum. A. Charlesby. Proc. Phys. Soc., B 66, pp. 317–329 (April 1, 1953). Light Metals Bull. 15, p. 298 (May 1, 1953).

This paper describes part of a series of investigations into the electric properties of thin insulating oxide layers formed electrolytically on aluminum and is limited to a study of the ionic current and the result-

FOR SALE

4 STEEL LEAD LINED **CHROME PLATING TANKS**

32' long—44" deep—18" wide—thickness of lead 3/8"—Used about one year.

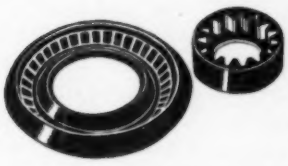
KARL NUSSBAUM AND SONS, Inc.
29th & Garland (Raymond 5741)
Louisville, Ky.

USE READER SERVICE CARD; INDICATE A 1051.
USE READER SERVICE CARD; INDICATE A 1052.

AMAZING TENSILE STRENGTH

PERMANENT FLEXIBILITY

CONTINUOUS ADHESION



RUGGED SCUFF RESISTANCE

POSITIVE INSULATION

DURABLE PROTECTION

When...

THEY'RE MICCROSOL COATED

They Meet the Highest Industrial Standards

MICCROSOL E-1003 Heat-Cured Rack Coating is a 100% solids, non-evaporating material that produces a smooth, tough, leather-like coating which will often outlast the rack. Exceptional adhesion is achieved through the use of our primers.

In addition to the outstanding characteristics listed above, tests for abrasion and resistance to all commonly used plating solutions, acids, and caustics show superior performance in comparison to similar products. MICCROSOL E-1003 has proven to excell as a coating for materials-handling equipment, baskets, hangers, and a wide variety of plating equipment parts.

MICCROSOL E-1003 has an exceptionally high gloss, allowing free drainage, and no solution carry-over.

We will be pleased to help you with your coating problems. Send us full particulars.

MICCRO Products

MICHIGAN CHROME

and Chemical Company

8611 Grinnell Avenue • Detroit 13, Michigan

FILTER 50-1500 GAL/HR ANY ELECTROPLATING SOLUTION

NO ROUGH DEPOSITS
NO PITTING

SERVICE: Filters practically any acid or alkaline solution from pH 0 to pH 14; removes particles down to one micron in size.

DESIGN: Filter Assembly fabricated of stainless steel 316, high temperature lucite, rubber-lined, Haveg or Sethrin* resin. Filter tubes of cotton, dynel, porous stone, or porous carbon. Pumps fabricated of Hastelloy, stainless 316, or plastic, centrifugal or self-priming. Motors drip-proof, totally enclosed, or explosion-proof, 110 or 220 volt, single or three-phase, 50 or 60 cycle, sleeve or ball bearing. Hose—12 ft. inlet and 12 ft. outlet, acid and alkaline resistant. Base—Phenolic base on rubber tire ball bearing casters.

Model	Rated Capacity	Overall Size	Weight
LSI-5	50 gal/hr	11" x 14" x 12"	30 lb
LSI-10	100 gal/hr	12" x 16" x 16"	40 lb
ASI-300	300 gal/hr	2' x 2' x 2'	125 lb
ASI-400	400 gal/hr	2' x 2' x 2'	135 lb
ASI-600	600 gal/hr	2' x 2' x 2'	150 lb

*Reg. App. For

Write for Literature

Sethco 72 Willoughby St., Brooklyn 1, New York

USE READER SERVICE CARD; INDICATE A 1054.

BEAM-KNODEL CO.

Distributors for

HANSON-
VAN WINKLE-
MUNNING CO.'S

"PLATEMANSHIP"

A Complete Service

for **Electroplating, Polishing and Buffing, Cleaning and Anodizing**

●

195 LAFAYETTE STREET

CA 6-3956-7 New York 12, N. Y.

Article Abstracts

ant film growth. It is shown that at a given temperature the ion current i is a function of the average electrostatic field strength F across the film.

The Formation of Intracrystalline Voids in Solution-Treated Magnesium-Aluminum Alloys. E. Lardner. J. Inst. Metals **81**, 439 (1953).

It has been observed that occasionally the solution treatment of cast magnesium-aluminum alloys results in the formation of small hexagonal voids in the centre of many grains. These voids have been shown to be orientated with their hexagonal axes parallel to the hexagonal axes of the crystals in which they occur. No explanation has been found for their formation, but it has been shown that in a sample of an alloy that does form cavities, the cavity formation increases to a maximum and then eventually vanishes with increasing homogenization. It has also been shown that the cavities are probably produced on cooling after solution-treatment rather than during the progress of the heat-treatment.

Priming Paints for Light Alloys. J. G. Rigg and E. W. Skerrey. J. Inst. Metals **81**, 481 (1953).

The results obtained from the exposure of light alloy specimens for 6 months in rural, industrial, and marine atmospheres, with various primers under aluminum top coats, have been published previously, and the present paper gives the further information obtained on continuation of the tests for 3½ years.

The results confirmed earlier indications. Zinc chromate and zinc tetroxychromate primers were superior in protective value to iron oxide primer, although the latter provided satisfactory protection, especially to aluminum in the less severe environments. Red lead primer was definitely harmful on light alloys, and especially on magnesium in corrosive environments. In these tests both types of chromate primer were found to be slightly preferable to red lead on mild steel. Zinc chromate and zinc tetroxychromate pigments are pre-

CHEMSTEEL CONSTRUCTION COMPANY, INC.

303 Chemsteel Building, Walnut Street, Pittsburgh 32, Pa.

(No "tie-in" with any manufacturer)

Send data on your Design, Engineering, Material, Construction and Maintenance Facilities for

ACID-ALKALI-PROOF CONSTRUCTION

backed by experience serving major steel, chemical, textile and food industries in erection of

PICKLING, PROCESSING & STORAGE TANKS & FLOORING

NAME.....

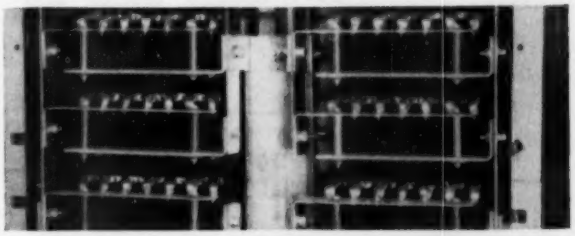
COMPANY.....

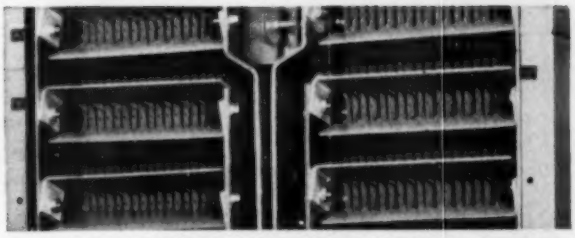
ADDRESS.....

CITY.....ZONE.....STATE.....

TEAR OUT AND MAIL

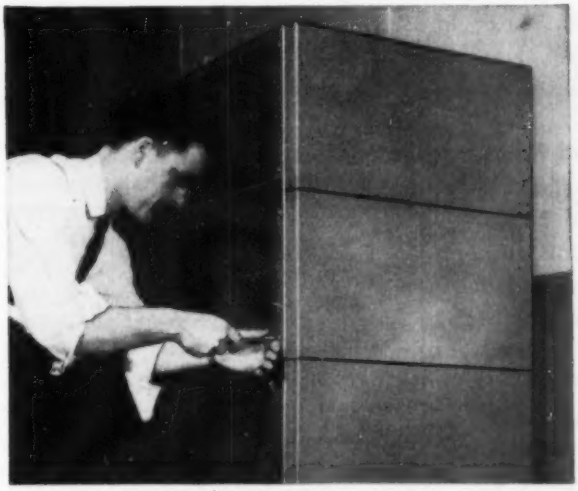
You Save Four Ways with G-E Plating Power Supplies

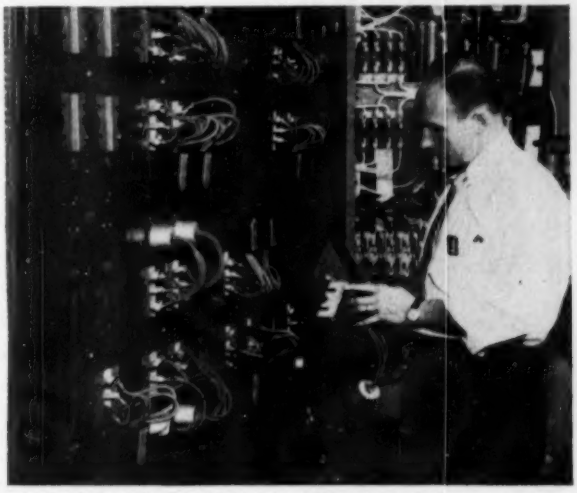




1 SAVE ON INSTALLATION COSTS with G-E Plating Power Supplies. No special foundations are required. Simply move rectifier unit into place with a fork truck, make connections, and it's ready to operate.

2 SAVE ON OPERATING COSTS. Maximum operating economy is obtained in every rating of G-E Plating Rectifiers by using either copper-oxide (top) or selenium (bottom) rectifier cells at their most efficient voltages.





3 SAVE ON MAINTENANCE COSTS. A cooling fan, requiring occasional lubrication, is the only moving part. All parts are corrosion resistant. Cooling design minimizes intake of dirt, dust and corrosive fumes.

4 SAVE ON EQUIPMENT LIFE. At rated output G-E copper-oxide rectifier stacks last almost indefinitely. On test stands G-E selenium rectifier stacks have maintained rated output for over 60,000 hours.

General Electric Plating Power Supplies are available for laboratory plating, barrel plating, and with manual or automatic regulation. For more information contact your nearest G-E Plating Rectifier agent or G-E Apparatus Sales Office, or write Section 464-13, General Electric Company, Schenectady 5, N.Y.

You can put your confidence in—

GENERAL ELECTRIC

LEA COMPOUND

★ 1923—Industry's Pioneering Greaseless Composition

★ 1953—Industry's Leading Greaseless Composition for Polishing—Buffing—Burring—Satin Finishing

THERE has never been any deviation in the quality of ingredients going into the making of Lea Compound . . . always the best available and always blended and compounded to maintain their excellent finishing characteristics.

There are grades in everything. We could use inferior and cheaper abrasives. We don't. We use the best obtainable for the work to be done. We could be a little slip-shod in grading them. We aren't. We carefully size all grits. We could use the cheaper glues. But we don't. We use the best hide glues on the market. We could use less time and care in mixing these ingredients and in filling the tubes. We don't.

Lea Compound—and it is symbolic of all Lea products—has made an enviable record in the field of clean, efficient, economical metal and plastic finishing. Use of the best materials and care in manufacture are major factors. The question confronting you is whether you can afford to do your finishing with inferior compounds . . . with anything short of the best.

LEA GRIPMASTER®
POLISHING WHEEL CEMENT
matching the high quality of other Lea Products, is now obtainable through
LEA-MICHIGAN, INC.
14066 Stansbury Ave.,
Detroit 27, Michigan

Burring, Buffing, Polishing, Lapping, Plating and Spray Finishing . . . Manufacturers and Specialists in the Development of Production Methods, Equipment and Compositions.

Manufacturers of Lea Compound and Learock . . . Industry's quality buffing and polishing compounds for over 30 years.

THE LEA MANUFACTURING CO.
16 Churry Ave. Waterbury, 20, Conn.
Lea-Michigan, Inc.
14066 Stansbury Ave., Detroit 27, Michigan
Lea-Ronal, Inc.
42-48 27th St., Long Island City, N. Y.
Lea Mfg. Company of Canada, Ltd.
370 Victoria Street, Toronto 2, Canada

ferred for primers for composite structures of steel and light alloys in severe exposure conditions, while iron oxide is adequate for milder conditions.

A Porosity Test for Electrodeposits on Zinc-Base Die-Castings. H. K. Lutwak, Trans. Inst. Met. Finishing **29** (1953).

A new method of determining the porosity of metal coatings on zinc-base die-castings has been developed. It uses a test solution consisting of ammonium chloride and potassium ferrocyanide. The ammonium chloride corrodes the zinc at the bottom of pores and keeps the zinc in solution; the ferrocyanide forms a white, insoluble compound with the dissolved zinc.

Irregularly shaped articles are first given a thin coat of shellac and are then completely immersed in the test solution; white spots grow on the sites of pores in the coating. For testing flat, cylindrical or conical surfaces, the solution may be applied by means of absorbent paper. The white compound shows up well on black paper; alternatively, if the compound is converted to suitably colored salts (e. g., ferric, cupric), white paper can be used.

The Present and Future Metallurgical Requirements of the Chemical Engineer. Sir Christopher Hinton. J. Inst. Metals **81**, 465 (1953).

Up till about 1925 the designer of chemical plant made use only of the range of constructional materials that had been developed for other purposes. In the last twenty-five years, however, the chemical engineer has made increasing demands on the metallurgist for new materials to meet his special requirements. In particular, the plant needed for operations in connection with the exploitation of atomic energy has presented a number of metallurgical problems. A brief survey of some of these is given.

It is suggested that a better range of halide-resistant materials is necessary, and that greater attention should be paid to methods of fabricating new materials.

FOR SALE

Slightly Used BUFFS

Loose and Sewed
Air-Cooled

Any Quantity

MICHIGAN BUFF CO., INC.

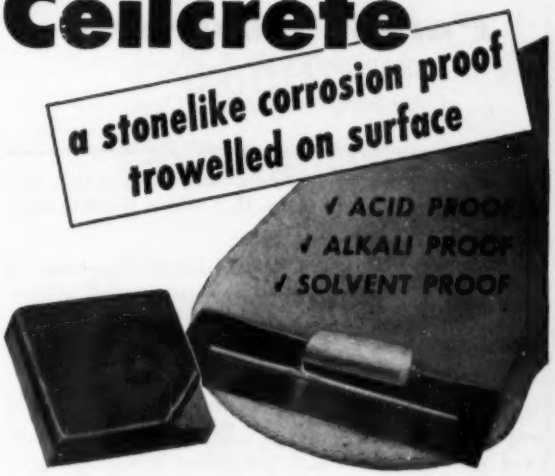
3503 GAYLORD AVE. DETROIT (12), MICHIGAN

USE READER SERVICE CARD; INDICATE A 1059.

Ceilcrete

a stonelike corrosion proof trowelled on surface

✓ ACID PROOF
✓ ALKALI PROOF
✓ SOLVENT PROOF



TOPPING for FLOORS • WALLS
ACID HOLDING TANKS • WASTE
DISPOSAL SYSTEMS, ETC.

THE CEILCOTE COMPANY
4832 Ridge Road, Cleveland 9, Ohio

Send for technical data on its application, corrosion resistance properties

USE READER SERVICE CARD; INDICATE A 1060.

today's "wonder drug" for industry

The greatest cost-saving labor-saving FINISHING DEVELOPMENT in a decade!

If you produce parts that require finishing, write today for *NEW, FREE* eye-opening 52-PAGE CATALOG, *"Supersheen Speed Finishing"*. Learn how Supersheen Speed Finishing saves up to 95% on almost all types of parts with absolute uniformity, fewer rejects, finer finishes!

Dept. C-9

ALMCO Supersheen

AMERICA'S LARGEST MANUFACTURER OF ADVANCED BARREL FINISHING EQUIPMENT – MATERIALS AND COMPOUNDS

ALBERT LEA, MINNESOTA

USE READER SERVICE CARD; INDICATE A 1061.

Patent Abstracts

GEORGE B. HOGABOOM
Consultant, New Britain, Conn.

Copies of patents may be obtained by writing to Commissioner of Patents, Washington, D. C. Price 25 cents each.

No. 2,643,221, June 23, 1953—Electrodeposition of Phosphorous-Nickel and Phosphorus-Cobalt Alloys. Abner Brenner, Dwight E. Couch and Eugenia K. Williams, assignors to the United States of America as represented by the Secretary of the Army.

CLAIM 1. The method of electrodepositing alloys of phosphorous with a metal of the group consisting of nickel and cobalt which comprises electrolyzing a solution containing said metal in the form of a salt chosen from the group consisting of sulfates and chlorides in the presence of phosphoric acid and phosphorous acid and having a *p*H of about 0.5 to 2.0.

CLAIM 2. . . . at a current density of about 5 to 40 amp/dm², said solution having a *p*H of 0.5 to 2.0.

CLAIM 3. . and a temperature of about 75 to 95° C.

CLAIM 4. . . . in which the said phosphoric acid is present in an amount of about 50 grams per liter.

CLAIM 5. . . . according to claim 4 in which the said phosphorous acid is present in an amount of from about 2 to 160 grams per liter.

CLAIM 6. An electrolyte for depositing alloys of phosphorous with a metal consisting of nickel and cobalt . . .

CLAIM 7. The method of electrodepositing an alloy of phosphorous with nickel which comprises electrolyzing a solution containing nickel in the form of a chloride in the presence of phosphorous acid and phosphoric acid at a current density of about 5 to 40 amp/dm² and a temperature of about 75 to 95° C, said solution having a *p*H of from 0.5 to 1.0.

7 claims, 5 figures.

References cited: U. S. Patent 2,069,566. British Patents 1,657; 10,133. Brenner et al, Proceedings, American Electroplaters' Society, June, 1946, pp. 23-26. Brenner et al, Proceedings, American Electroplaters' Society, June, 1947, pp. 156–160–167–168. Watts, Transactions Electrochemical Society, Vol. 23 (1913), pp. 133, 139, 141, 142. Kalmus, Electroplating with Cobalt. Part III, Department of Mines (Canada), 1915, pp. 45–46.

No. 2,643,225, June 23, 1953—Electroplating Rack—H. F. Jones and H. R. Colby, Assignors to Federal-Mogul Corporation, Detroit, Mich.

. . the result of 10 years of development

the 2SHOMC *

Beware of patent infringements and inferior imitations.

NO "COLD FLOW" PROBLEM WITH DOOR LOCKS •

• DIRECT HARDENED STEEL SPUR DRIVE (NO "FLABBY" CHAINS)

• ONE-PIECE BEARING HOUSING

• SUPER HIGH GRADE STAINLESS ALLOY BEARINGS

ALL LAZO PLATING BARRELS REG. UNDER U.S. PAT. 2,491,925 AND CAN. PAT. 445,821.

* This is a patented unit, as are all LAZO plating barrels, registered exclusively under the name of HARDWOOD LINE MFG. CO.

PLATING LAZO PRODUCTS

HARDWOOD LINE Mfg. Co.
Lucite Cylinders for Complete Cycle Plating
Unexcelled Service
2022 N. CALIFORNIA AVE. • CHICAGO 47, ILLINOIS • Dickens 2-9393

Originators of Ribless Plating Barrels

CLAIM 1. In a rack for electroplating hollow articles, a frame comprising an upper end element having a pair of spaced downwardly depending legs which are provided with inwardly projecting flanges at their lower end portions, an upper and lower end member positionable between said legs, a first pair of angle bars carried by one said end members and extending toward the other said end members, and a pair of abutments carried by said other end member and clamping engaging the extending end portions of said bars, said end members having a first dimension in a plane extending transversely of said legs and of a magnitude less than the distance between said flanges whereby said end members may be inserted longitudinally of the legs between said flanges into the space between said legs, said lower end member having second dimension in said plane of a magnitude greater than the distance between said flanges but less than the distance between said legs, said second dimension being aligned with said flanges whereby said lower end member seats on and is supported by said flanges.

2 claims, 5 figures.

References cited: U. S. Patents 1,861,446; 1,872,290; 2,323,952; 2,370,970. Serial No. 255,974, Krell (A.P.C.) published June 8, 1943. Belke Plating Rack Manual, Belke Manufacturing Co., Chicago 51, Ill., 1944, p. 433. Metal Industry (New York, September 14, 1945), pp. 170–172.

No. 2,643,975, June 30, 1953—Method of Lead Coating a Ferrous Article, R. A. Neish, assignor to U. S. Steel Corporation.

I have found that an adherent, uniform outer coating of substantially pure lead can be applied to iron or steel by:

(1) Electroplating the ferrous article with a thin coating of tin, 0.2 to 0.6 lb per double base box.

(2) Heating the tin plated article so as to melt and transform substantially all of the tin into a continuous layer of iron-tin alloy and then

(3) Dipping the article in a molten bath of substantially pure lead.

CLAIM 1. The method of applying an adherent coating of substantially pure lead to a ferrous metal article which consists of electroplating the article with a tin coating between 0.000003 and 0.000018 inch in thickness, heating tin plated article to a temperature between melting point of tin and 650° F, to substantially completely alloy said tin with the surface of said article, and then immersing in a molten lead bath.

4 claims, 1 figure.

References cited: U. S. Patents 779,887; 1,596,300; 1,738,748; 1,745,185; 2,115,750; 2,266,330; 2,381,778; 2,428,318; 2,490,700.

No. 2,644,787, July 7, 1953—Electrodeposition of a Magnetic Coating. T. H. Bonn and D. C. Wendell,

Seeley Compounds

—

offer a choice of the
Right Type
For All Metal Finishing

—

Burring — Polishing — Buffing

—

E. E. SEELEY COMPANY, INC.
Bridgeport, 1, Conn.

USE READER SERVICE CARD; INDICATE A 1063.

NOW *FASTER* SERVICE on Rubber Lining at Good Prices!

To protect against corrosion in the handling, storage, or transportation of chemicals requires specialists' knowledge and facilities. Acme-Fisher engineers formulate the necessary rubber or synthetic lining or covering your job requires to meet the temperatures, pressures, and peculiar corrosive characteristics of the chemicals involved.

With complete facilities under direct control, Acme-Fisher can supply your new-steel requirements without delay, and deliver complete with the precisely right protective lining or covering in the shortest possible time and at an attractive price.

Let us quote on your specification. No obligation.

Write today—attention Mr. W. Partridge.

Or ask for your free copy of Acme-Fisher's helpful guide to anti-corrosion, anti-abrasion coverings.

ACME-FISHER
LOUISVILLE 2, KENTUCKY
Anti-corrosive Linings and Coverings
NO EQUIPMENT TOO LARGE or TOO INTRICATE

Pressure Blast Application #304

Before Pressure-Blasting

After Pressure-Blasting and hard chrome plating

These 2S aluminum components were plated directly with .001" of chromium on the two shoulders immediately after Pressure Blasting as the only pre-plating operation! Seven individual dips and strikes formerly required to prepare surfaces for chrome plating were eliminated. Adherence has now proved excellent.

ONLY PRESSURE BLAST GIVES YOU 2-SPEED WET-BLASTING

FREE . . . Learn what PRESSURE BLAST can do for you! Die and Mold Polishing, Blending Grind Lines, Deburring, Heat Treat Scale Removal, Honing of Cutting Tools, Pre-plating Cleaning . . . Hundreds of proven, money-saving applications!

Write for our new 8 page fully illustrated Booklet . . . or send samples of work you want tested to:

MODEL A . . . ONE OF 4 STANDARD UNITS. CUSTOM MACHINES DESIGNED TO FIT SPECIAL REQUIREMENTS.

The ENO-PLATE Company, Incorporated
747-1 Windsor Street
Hartford 5, Conn.

USE READER SERVICE CARD; INDICATE A 1065.

Simplify purification of your cyanide zinc plating solution with

McKeon's Zinc-Brite

CUTS DOWN "BRIGHTENER" CONSUMPTION

Wire or phone collect for information

Sulphur Products Co. Inc.
Greensburg Pa. 8

Patent Abstracts

Jr., assignors to Eckert-Wauchly Computer Corporation, Philadelphia, Pa.

Attempts have heretofore been made to produce magnetic carriers for recording purposes by plating bronze or brass tapes with a thin coating of a cobalt-nickel alloy. Such magnetic carriers, however, have had certain disadvantages, in that, in order to provide the necessary properties in the magnetic coating, heat treatment has been required which results in non-uniformity in the final product. In accordance with the present invention, there is produced by a novel plating process a deposit of magnetic material which has, without the necessity for subsequent heat treatment, the desired magnetic properties of high coercivity and substantial remanence and at the same time excellent physical properties such as adherence to the base material, a bright smooth surface and great hardness as well as high resistance to corrosion.

CLAIM 12. The method for the deposition of a magnetic coating on an electrically conductive carrier as cathode to at least partial electrolytic action in an aqueous bath containing nickel and cobalt chloride and sodium hypophosphite and characterized by a *p*H of approximately 4 and including as essential constituents nickel ions in a concentration approximately 0.84N, cobalt ions in a concentration approximately 0.84N, hypophosphite ions in a concentration approximately 0.145N, and ammonium chloride in a concentration approximately 1.9N, the current density being approximately 50 amperes per square foot of carrier surface area exposed in the bath, and said electrolytic action being in the presence of the reducing action of the hypophosphite ions on the cobalt and nickel ions.

12 claims.

References cited: U. S. Patents 2,430,581. Brenner et al, National Bureau of Standards Research Paper R.P. 1725 Vol. 37, July 1946, 1–4. Young et al, Transactions, Electrochemical Society, Vol. 89 (1946), pp. 383–386, 389–396, 399–402.

No. 2,644,788, July 7, 1953—Electrodeposition of Nickel. W. J. Shenk, Jr., assignor to The Harshaw Chemical Company.

CLAIM 6. A method of electrodepositing nickel on a metallic surface in the form of a deposit which is bright as taken from the plating solution without further treatment; and which is ductile and smoother than said metallic surface when root mean square average deviation of irregularities in the surface thereof from the average surface plane is about 10 to 15 microinches, and the thickness of the deposit is about 0.001, which method comprises electrolizing an aqueous, acid solution of a nickel electrolyte of the class consisting of nickel sulfate, nickel chloride, and mixtures of nickel sulfate with nickel chloride, said solution also containing cooperating addition agents capable of imparting brightness and smoothing power as aforesaid, one

THE NEW ROHCO® Hanging Hull Cell

NOW You Can SEE Under Actual Production Conditions!

FROM THE METER . . .

- Average operating current density
- Current variation throughout the tank
- How to locate poor anode contacts
- How to distribute anodes
- Proper current for making laboratory Hull Cell tests in your plating range

FROM THE TEST PANEL (Steel, Polished Brass) . . .

- The progress of the plating process at any given time—even in Full Automatics
- The effects of agitation (otherwise impossible to study)
- The effects of temperature (difficult to study in the laboratory)
- The overall performance of the entire finishing operation (Buffing, Cleaning, Plating*.)
- The bright plating range and effect of impurities
- Even sequence plating such as copper, nickel, chrome

SEE Your ROHCO DISTRIBUTOR For A Demonstration

R. O. HULL & COMPANY, INC.
1302 Parsons Court
Rocky River 16, Ohio

Canada: Armalite Company, Ltd.
Toronto 6, Canada

"YOUR PLATING IS BEST WITH THE HULL CELL TEST"

JUST PIN THIS COUPON TO YOUR LETTERHEAD!

R. O. HULL & COMPANY, INC.
1302 Parsons Court
Rocky River 16, Ohio

Please send details on the new ROHCO HANGING HULL CELL

Name..... Title.....
Company.....
Street Address.....
City..... Zone..... State.....

of said addition agents being 1-(carboxymethyl) pyridinium chloride and being present in concentration from 0.1 to 1.0 gram per liter, and the other of said addition agents being saccharine in concentration from 0.5 to 2.5 grams per liter.

6 claims.

References cited: U. S. Patents 2,315,802; 2,513,280; 2,550,449. Raub et al, Metal Finishing, August, 1940, pp. 429–432. Silman, Metal Industry, November 24, 1944, pp. 330–332.

No. 2,660,022, May 26, 1953—Composition, Bath and Process for Chromium Plating—J. E. Starek, Assignor to United Chromium Incorporated.

The present invention provides a bath and process having numerous advantages, among which are: (1) self regulation of catalyst acid radical content at or near the optimum concentration in baths of any desired chromic acid content; (2) reduced or eliminated need for analytical control; (3) the ability to take up appreciable amounts of catalyst acid radical introduced as impurities or as drag-in without exceeding the operating limits in the bath for such radicals; (4) superior covering power; (5) high operating efficiency such as low power consumption, minimum rejections and low operating costs; (6) wide brightplate range; (7) high plating speed; (8) good cathode activating properties; (9) bright plate directly on stainless steel; (10) avoidance of iridescent film on articles only partly covered in chromium plating.

Example I	*Per Cent*
Chromic acid	70–90
Potassium bichromate	5.5–15.5
Strontium chromate	0.6– 3.6
Potassium silicofluoride	2.5– 7.5
Strontium sulfate	1.4– 3.4

Claim 1. A composition of matter for making up an aqueous chromic acid bath for chromium plating in the range of 100 to 500 g/l of CrO_3, comprising essentially about 72 to 97 per cent by weight of CrO_3, an amount of strontium sulfate sufficient to saturate said bath and to provide an undissolved residue of strontium sulfate in the bath, an amount of potassium silicofluoride sufficient to saturate said bath and to provide an undissolved residue of potassium silicofluoride in the bath, a soluble non-catalytic strontium compound in an amount containing 0.21 to 5.3 per cent by weight of strontium, and a soluble non-catalytic potassium compound in an amount containing 0.64 to 4.7 per cent by weight potassium.

24 claims, 9 examples, 3 graphs.

References cited: U. S. Patents 1,857,547; 2,040,881; 2,050,478; 2,095,995.

PARAMOUNT BRAND
FELT WHEELS

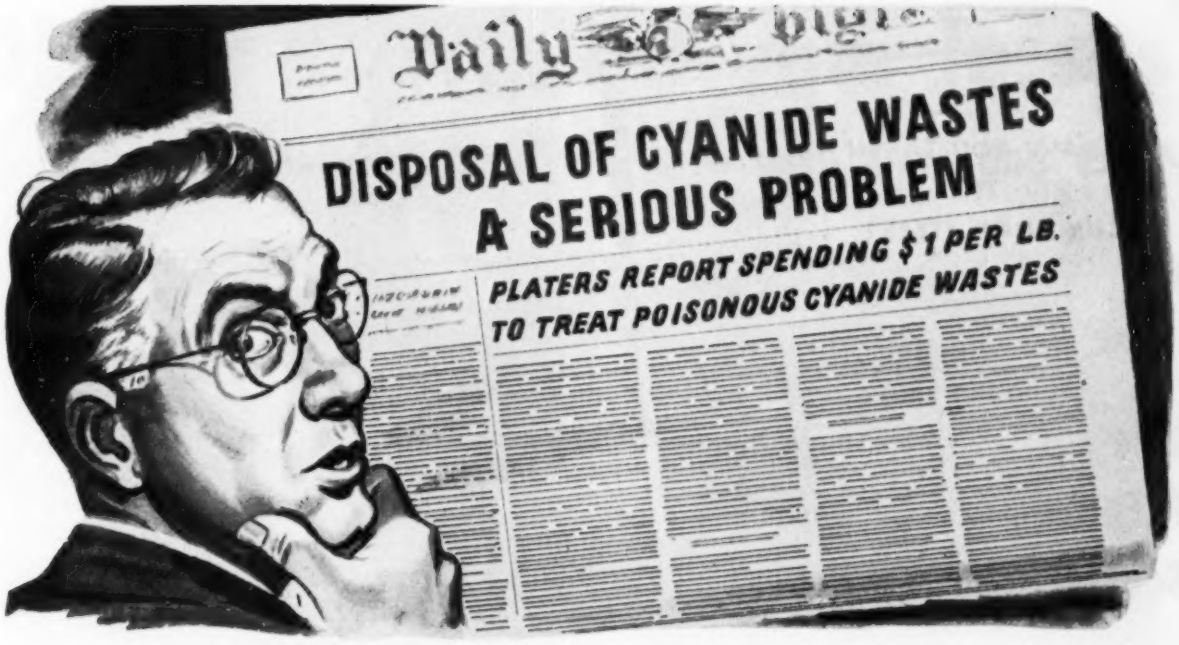
...TOPS IN "Contourability"

Are you finishing articles which require a wheel with a "shaped" or contoured face? Don't forget that felt wheels lend themselves to contouring probably better than any other type of wheel. Don't forget, too, you have nine degrees of hardness to choose from when you buy Bacon Felt Wheels—The Paramount Brand. Ask your supply house for Paramount Brand Felt Polish Wheels.

Send for Our New Catalog

BACON FELT COMPANY
407 West Water Street
TAUNTON
"America's Oldest Felt Manufacturer"
Established 1825
MASSACHUSETTS
"Felt Does It Better"

Your Supply House can Furnish Bacon PARAMOUNT BRAND FELT BOBS & WHEELS



Cyanide Disposal Problems Minimized

by the UNICHROME Pyrophosphate Copper Plating Bath

S-M-O-O-T-H PLATING.

The fine-grained Unichrome deposit gives smoothness without the need for brighteners.

BUFFING TIME IS CUT.

If needed at all, buffing of this ductile copper takes little time, less effort.

ANODES CORRODE EVENLY.

Unichrome bath needs fewer anodes to maintain copper in solution. It keeps anodes clean and efficient.

EASILY CONTROLLED.

Unichrome Copper is stable bath, constituents are readily analyzed, has good tolerance for impurities.

ONE BATH FOR ALL JOBS.

It plates steel, zinc die castings, aluminum, intricate shapes; provides suitable undercoat for nickel, chromium; excellent stop-off for nitriding, carburizing.

Cyanide wastes *have* to be treated before disposal due to high toxicity. But installing a treating unit is expensive. So is cost of materials used.

Platers have reported spending as much as $1 for materials alone to treat each pound of cyanide waste. Add to this the cost of space required by waste treating equipment, labor costs for operating it, the high initial investment and the subsequent maintenance and you see why it all adds up to a sizable increase in plant operating costs.

The more cyanide you have, the greater this expense. But, like many other platers, you can minimize, and in some cases completely eliminate, this expense by using the Unichrome Pyrophosphate Copper Plating Solution. This bath offers greater safety because it: (1) contains no cyanide (2) is less caustic (3) has low copper concentration (4) operates at moderate temperatures.

In addition, Unichrome Copper offers outstanding advantages in operation, such as those described at left. Learn more about how this plating process can help you do better, safer plating at less cost. Write for bulletin CU-2, or discuss it with a United Chromium engineer.

UNICHROME
Trade Mark

COATINGS FOR METALS

UNITED CHROMIUM, INCORPORATED

100 East 42nd St., New York 17, N. Y. • Detroit 20, Mich.
Waterbury 20, Conn. • Chicago 4, Ill. • Los Angeles 13, Calif.
In Canada: United Chromium Limited, Toronto 1, Ont.

This FREE New Booklet Tells You How

In its 28 illustrated pages you'll find the answers to many questions that affect the success of your electroplating on steel. You'll want to read more about:

¶ Which costs more: good electrocleaning or poor electrocleaning? *See page 4.*

¶ How can cleaning costs be reduced 33% while plating quality is being improved? *See pages 7 and 8.*

¶ What are four easy ways to improve the average rinse tank? *See page 10.*

¶ What rinsing fault is "an invitation to trouble" in the plating of high-carbon steel? *See page 11.*

¶ Why is it better to clean steel with reverse current than with direct current? *See pages 12 to 14.*

¶ What causes hydrogen embrittlement during electrocleaning? What is the remedy? *See pages 15 and 16.*

¶ One part chromic acid in 1,000,000 parts of cleaning solution—does that spell D-A-N-G-E-R? *See page 16.*

¶ How can an ordinary electrocleaning cycle be transformed into an exceptionally good cycle? *See Cycle E on page 23.*

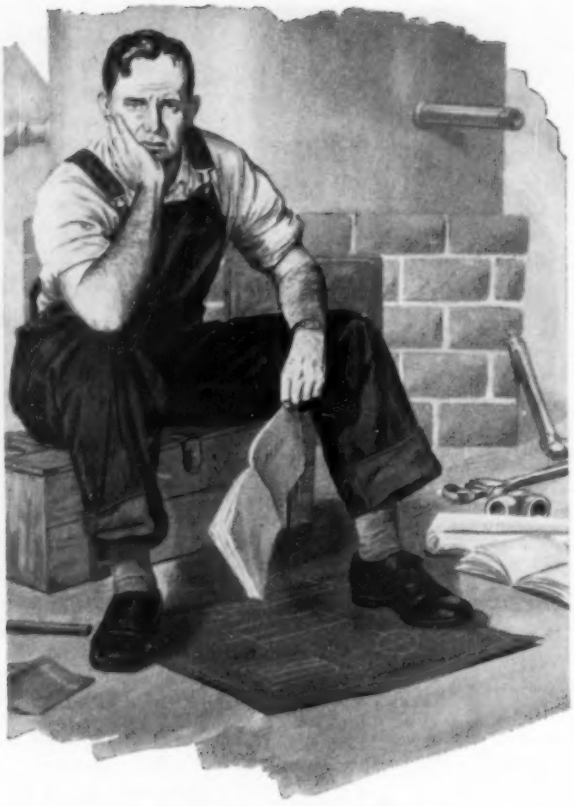
FREE For a copy of "*Four good steps toward better electroplating on steel*", write to Oakite Products, Inc., 40 Rector St., New York 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING

OAKITE

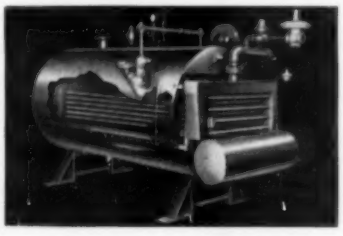
MATERIALS • METHODS • SERVICE

Technical Service Representatives in Principal Cities of U. S. & Canada



FOR PLATING EFFICIENCY - - - BUY A BOILER YOU CAN UNDERSTAND . . .

Any plating department interested in getting more steam—quickly, efficiently and economically—should know more about the *Sellers Immersion Steam Boilers*—and its *remarkable and simple design.*
Each of the many long tubes are *individually gas fired*—and therefore *uniformly heated.* Furthermore, they are completely submerged, nearer to the water level *and 100% water backed!*
Every one of Sellers 12 models is complete—no burners, instruments, or accessories to buy.
Every feature of the Sellers line of Boilers combine to give you years of trouble free efficiency at *remarkably* low costs.



Sellers

ENGINEERING CO.

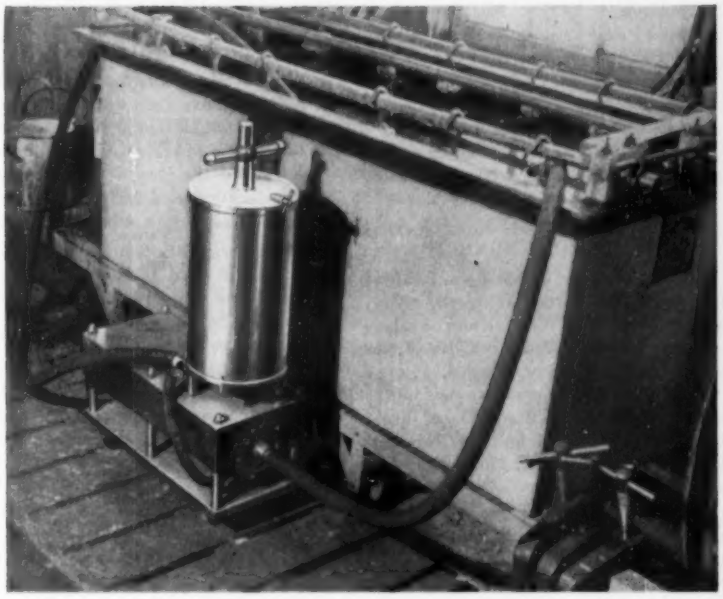
4876 N. CLARK STREET, CHICAGO, ILL.

Immersion Automatic Water Heaters Combustion Units Industrial Gas Burners Blast Heaters Vertical Steam Boilers Immersion Tank Heaters Immersion Steam Boilers

SEND FOR BULLETIN 1206 C-F-4
Your letterhead will bring you this roll all, dollar saving story on all 12 sizes!

Here's how to cut your losses

get better finished plated work — save time and labor



The "Sealed-Disc" Filter will remove all dirt, dust, and sludge from your plating solutions. You'll no longer worry about pitting, spotting, poor adhesion, formation of nodules, etc.

More and more platers testify to the remarkable savings in operating time and labor that the "Sealed-Disc" Filter gives them. These cost-minded platers get better finished plated work and have found that their solutions last longer. "Sealed-Disc" Filters, designed to meet plating room requirements, are smaller, more compact and portable, than ordinary conventional filters.

Regardless of the size or type of your installation, there's a "Sealed-Disc" Filter to "fit your job." You can depend on a "Sealed-Disc" Filter for positive, trouble-free performance that's proof against even the invisible impurities that cause nodules and porousness, proof against losses caused by rejects and reworking. Write for complete details or contact your regular plating supplier.

ALSOP ENGINEERING CORPORATION

809 Fine Street Milldale, Connecticut

Other Alsop Plating Room Equipment

We manufacture a full line of Mixers and Agitators covering a complete range of sizes, for mixing, blending, and dissolving. Stainless Steel Mixing Tanks are also available in a wide range of capacities. For full details and illustrations write for your free catalog.

Branch News

BUFFALO BRANCH

The following officers were elected for the fiscal year 1953–1954:

President—James Moneypenny
First Vice-President—W. M. Fotheringham
Second Vice-President—A. A. Janis
Third Vice-President—B. P. Fortin, Jr.
Secretary—Eric G. Sampson, Jr.
Treasurer—Roland E. Campbell
Librarian—Robert F. Hoffman
Sergeant-at-Arms—C. J. Wernlund
Board of Managers—Anthony Nigro, Joseph Ruff, O. Bert Kirchoff

MELBOURNE BRANCH

The 79th regular meeting was held on July 16 at Melbourne Technical College, with President G. Walker and 45 members and visitors present. Slides of the recent Convention were screened.

After the acceptance of two new members, Committeeman John Dale introduced the speakers for the evening, Messrs. K. Voss and D. Glanville, on the subject, "Silver Plating".

Voss outlined experiences with silver plating as practised as a decorative finish in plants in Germany, and Glanville gave practical experience of heavy deposits of silver as used in the aeronautical engineering field, mainly on bearing surfaces. Interesting exhibits were shown of heavy deposits, and jigs used.

After an interesting discussion period, a vote of thanks to the speakers was proposed by Clive Dalgleish.

Meeting closed at 10 P. M.

S. B. Pearce,
Secretary-Treasurer

PHILADELPHIA BRANCH

A regular meeting was held on May 22 at Mosebach's Restaurant with about 35 attending. The speaker was Donald M. Hutchinson, Harshaw Chemical Company, who spoke on Lead-Tin Alloy Plating. He pointed out that the 5 per cent tin alloy with lead gives the maximum corrosion protection. He discussed the chemistry of fluoboric acid and lead and fluoborates. Only the use of addition agents permits lead and tin alloys to be plated. Described was an investigation to determine effect of fixed amounts of resorcinol and glue on the various amounts of tin in the bath. Also discussed were equipment used and the analytical procedures for bath and deposit.

Four applicants were accepted.

The secretary gave a resume of the Supreme Society's annual budget reports and financial statement.

Dr. Heiman reported that Mr. Albert Hirsch was in the hospital and asked that flowers be sent and also visitors to see him.

The meeting adjourned at 9:55 P. M.

I. Wm. Marcovitch, *Secretary*

SAN FRANCISCO BRANCH

The May meeting was held at the El Curtola Restaurant, 510–17th St., Oakland, Calif., and was called to order by First Vice-President Robert Hart, who spoke on the subject of attendance and suggested a committee be formed to call members before a meeting to ascertain whether they will attend.

The Secretary was directed to compile a list of the members with their business addresses and home addresses and submit it to the Vice-President, who will, in turn, break down the list, assigning approximately ten persons for each member of the committee to call prior to the meeting.

The matter of the San Francisco Branch by-laws was then brought up since the Branch does not have any, a fact substantiated by the Secretary, who had made a thorough search of the San Francisco Branch files and had contacted the Executive Secretary in this regard. Hart formed a committee, appointing himself as Chairman, along with Jack Hite and J. R. Pattenger, to write the by-laws of the Branch. The Secretary, in turn, turned over a copy of the New York Branch by-laws to Chairman Hart.

The subject of a Branch library was brought up and the Secretary was directed to write to the Executive Secretary concerning establishing a file of publications in the San Francisco and Oakland libraries. The Secretary reported that he had done some work on this and would continue to work on it. J. R. Pattenger said he would contribute the 1950–1951 *Proceedings* to this good cause. The Secretary will report on this matter after arrangements have been completed. The question was brought up about the cost and a discussion favored the Branch bearing this expense if necessary. The Secretary pointed out that the library itself cannot purchase the *Proceedings* but would be willing to keep them for reference in event the Branch was willing to bear the expense.

The meeting was then turned over to a round table discussion, which covered such subjects as rectification, surface potentials, and current density distribution in the plating of some of the new alloys that are becoming increasingly evident in the electronic field.

The June meeting was held on June 11, at Gino's, Front and Clay Sts., San Francisco. Items on the agenda for discussion were:

(1) Discussion of the Branch by-laws being set up by an appointed committee.

(2) Discussion on the timing of the business session. It was suggested that they be held separately from the regular meeting and be conducted by the Board of Managers and Secretary or other officers.

(3) Discussion on speakers for the coming year. Floyd Browning suggested we try to get a number of metal finishing speakers. Fred Huntington suggested that we might have some discussion concerning lacquers.

The meeting was adjourned, with 14 members present.

Horace J. Smith,
Secretary-Treasurer

SYRACUSE BRANCH

The April meeting was held at Bill Richards' Restaurant, 106 Ashdale Ave., Syracuse, N. Y., on April 20. Fifty members enjoyed the usual pre-meeting sirloin of beef dinner.

Bob Guffie, technical representative of United Chromium, Inc., was introduced by Branch Librarian Walter Piasecki. Guffie's talk for the evening was "Industrial Hard Chrome Plating". This was one of the best meetings of the year and was enjoyed by the record turnout of 67 members.

Refreshments were provided by the Cowles Chemical Company of Cleveland, Ohio, with their representative, George Wolebeen, acting as host.

The May meeting was held on the 18th. Thirty-six members and guests attended. Thirty-one members were on hand for the pre-meeting meal of sirloin of beef.

The speaker of the evening was E. P. Roland, sales engineer of Sarco, Inc., New York, N. Y., who spoke on the subject, "Heating and Temperature Control of Plating Solutions". Mr. Roland gave an unusually interesting talk on the subject.

Refreshments were provided by Frederic B. Stevens, Inc., with their representative, Ed Elliot, acting as host.

The Branch Annual Clambake was held on Saturday, June 6, 1953—at McDonells Park, Oneida Lake. One hundred members and guests finished up the Branch season in grand style at this outing.

Lindley S. Wood, *Secretary*

WATERBURY BRANCH

The last regular meeting of the fiscal year was held on May 14 at the Hotel Elton with 35 members attending. President Francis T. Eddy opened the meeting and turned the educational session over to Technical Chairman David Maitland.

Introduced as guest speaker was Harold E. Weaver, of Rohm and Haas Company, Resinous Products Division. His subject was "Application of Ion Exchange Resins to Plating Room Rinse Water".

The paper covered the application of ion exchange membranes and ion permeable membranes. The following is a summary of his talk.

Basically, ion exchange resins are in-

SLASH COSTS

of plating Equipment Protection with CYCLOFLEX PC-11

A Heat-Converted Plastisol!

MUNRAY PRODUCTS for INDUSTRY

For light duty Rack Coating and Quick Patching use AIR-DRY CYCLOFLEX PC-7.

Yes, CYCLOFLEX PC-11 will slash Equipment Protection Costs in five ways—

It is quickly and easily applied. One coat primer (Applied by dip, spray or brush) and one coat PC-11 are all that are required for either ferrous or non-ferrous metals.

It is designed for heavy duty service and gives long service life with little maintenance.

It speeds production because its tough, smooth, glossy surface allows complete drainage, insures full rinsing and eliminates dragout and contamination.

It coats more surface per gallon because of its 100% solids formula.

It is a packaged unit — the 55-gallon open head drum in which it is shipped can be used as a dip tank.

CYCLOFLEX PC-11 is outstanding for its chemical resistance to all plating operations solutions, baths, cleaners, etc.—And it is time-tested in hundreds of plants.

CYCLOFLEX PC-11 is ideal for use on all plating plant equipment such as racks, pails, funnels, screens, etc. It is unexcelled for protection and satisfaction.

YOUR SUPPLY DEALER CAN GIVE YOU FULL INFORMATION AND CAN FURNISH PC-11. CONTACT HIM TODAY.

MUNRAY *Products, Inc.*

12400 CROSSBURN AVE. CLEVELAND 11, OHIO

DIVISION OF FANNER MANUFACTURING CO.

soluble organic polymers, containing reactive groups which are either acidic or basic in nature. This structure permits these materials to function as though they were insoluble acids and bases, which, nevertheless, are able to enter into neutralization reactions. They cover the range from strongly acidic, comparable to sulfuric acid; weakly acidic, comparable to acetic acid; weakly basic, comparable to ammonia; and strongly basic, comparable to sodium hydroxide.

Granular ion exchange resins are useful for ion adsorption, primarily from dilute solutions, usually at concentrations less than 1,000 ppm, although under special circumstances, they may be applicable to concentrations up to 2,000 to 2,500 ppm.

Ion permeable membranes are ion exchange resins in sheet form. These materials are of interest primarily because they exhibit selective permeability to ions of one charge while substantially blocking the passage of ions of the opposite charge.

L. J. Bakinow,
Publicity Chairman

Branch Speakers List
1953-1954

Additions to list published in August Issue.

(c) Expenses paid by Company
(b) Expenses paid by Branch
(b or c) Expenses to be negotiated

LESLIE E. LANCY (c)
Country Club Drive, Elwood City, Pa.—Any Branch
Subject:
Electroplating Waste Treatment

MAAS & WALDSTEIN COMPANY (c)
2121 McCarter Highway, Newark 4, N. J.—Any Branch
B. F. Ames, Sales Manager
Subject:
New Developments in the Field of Organic Coatings

MINE SAFETY APPLIANCES CO. (c)
Braddock, Thomas and Meade Sts., Pittsburgh, 8, Pa.—Any Branch
Contact B. W. Catalane, Assistant Manager for nearest speaker
Subject:
General talks on health hazards and safety in plating operations
There is an educational movie available, *The Air We Breathe*—(20-minutes-sound)—covering the common types of air contaminants found in industrial processes and the personal protective equipment used to prevent the worker from breathing them

THE PERMUTIT COMPANY (c)
330 W. 42nd St., New York 36, N. Y.—Any Branch
A. B. Mindler and C. F. Paulson, Special Applications Department
Subjects:
1. *Recovery of Metals in the Plating Shop by Ion Exchange*
2. *Application of Demineralized Water in the Plating Room*

OAKITE PRODUCTS, INC. (c)
19 Rector Street, New York 6, N. Y.—Any Branch.
Dr. Donald Price; Gerald Lux and Martin Maher
Subject:
Varied subjects in the cleaning field

Fidelity

ENGINEERED COMPOUNDS

ZIPSOL METAL CLEANER No. 74
(Degreasing Solvent)
SAFE · EFFICIENT · ECONOMICAL

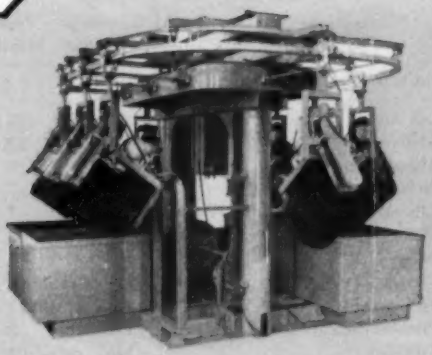
ZIPSOL METAL CLEANER No. 74 is a superior metal cleaner and degreasing solvent. It removes heavy grease, oil and buffing compounds . . . quickly, safely and thoroughly. Is amazingly economical, too, because it may be highly diluted with inexpensive kerosene or mineral spirits and will retain maximum efficiency. Easy to use in tank or spray . . . at room temperature.

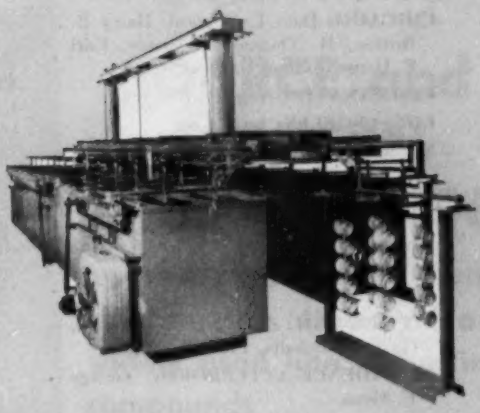
Write, detailing your metal cleaning problems. Our Laboratory Staff will be glad to make recommendations . . . no obligation, of course!

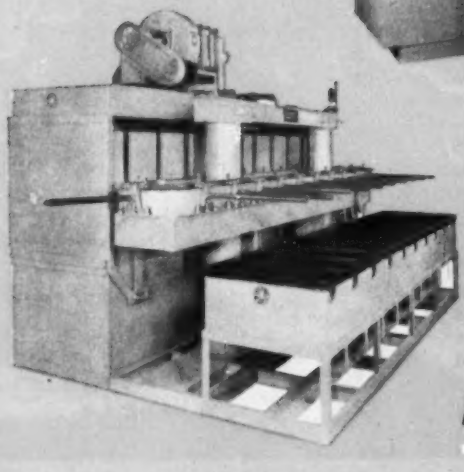
SPECIALISTS IN METAL CLEANERS AND PAINT STRIPPERS
FIDELITY CHEMICAL PRODUCTS CORP.
477 Frelinghuysen Avenue, Newark 5, New Jersey

for
METAL FINISHING & PLATING

CROWN AUTOMATICS



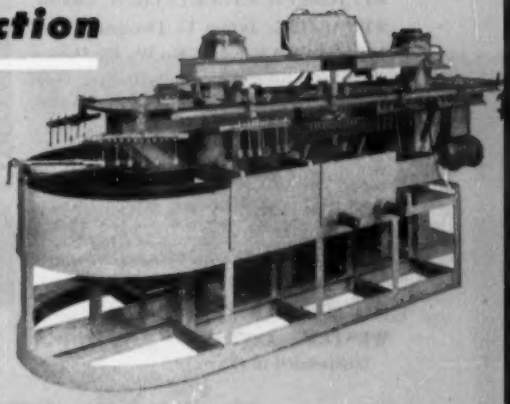


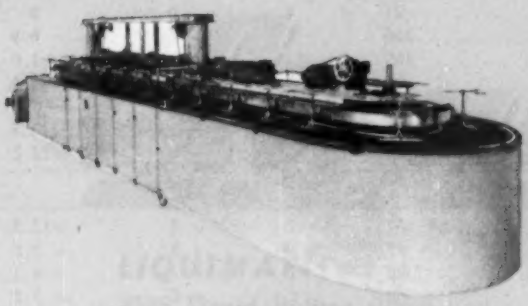


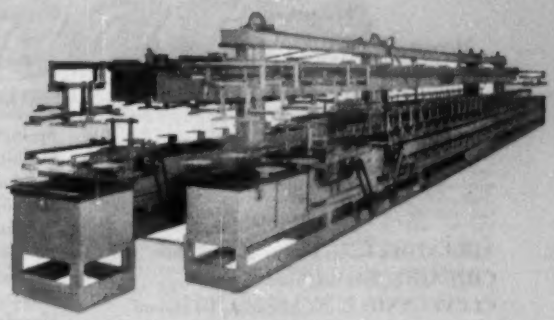
increase production

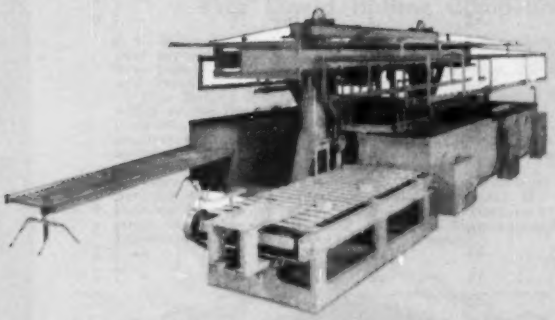
reduce costs

improve quality









Crown Automatics are ideal for plating your barrel or racked work. Crown manufactures the widest variety of fully automatic plating machines in the industry . . . *there is a model to fit your needs.* Write us details of your job and production requirements.

CROWN RHEOSTAT AND SUPPLY COMPANY

3465 N. KIMBALL AVENUE • CHICAGO 18, ILLINOIS

INDICATE A 1075.

Membership Report of the A. E. S.

Elections

ADELAIDE: W. Pietuszko

CHICAGO: Dale T. Blizzard, Harry E. Britton, R. Thomas Fallbacher, Carl F. Hansen, James Ondrus

CINCINNATI: George D. Bennett

LOS ANGELES: Irvin Kort

MELBOURNE: Thomas W. Brown, Kenneth M. Linford, Eric J. O'Toole, William J. Payne, Gordon J. Perkins, Frederick A. Rule, Kenneth L. M. Staggard

MILWAUKEE: Louis E. Carr, William K. Platt

PITTSBURGH: Edward A. Dantini, George Karchella, Frank D. Porter

PROVIDENCE-ATTLEBORO: George E. Mona

ST. JOSEPH VALLEY: Leo N. Davies

SYRACUSE: James C. Demperio

MEMBER-AT-LARGE: W. G. Poeton, Bristol, England; R. Reitsema, Delft, Holland; Lloyd P. Sharts, Seattle, Wash.

Reinstatements

MELBOURNE: F. H. Chapman (suspended in error)

NEW YORK: William W. Sellers, Jr. (suspended in error)

SYRACUSE: Stephen J. Egged

WESTERN ONTARIO: A. V. Corbet (suspended in error)

Transfers

Merritt J. Lillis to Chicago from Detroit; E. H. McCoy from Chicago to Milwaukee; Philip LoPresti to Philadelphia from New York; August B. Hoefer to Detroit from Philadelphia; Douglas L. Carle to Newark from Pittsburgh

Resignations

ADELAIDE: L. G. Leane, R. C. Leane

CHICAGO: Samuel Kaplan

CLEVELAND: L. N. Albrecht, Raymond E. Smith

LOUISVILLE: Norman W. Johnson

MILWAUKEE: Robert P. Crooks

PITTSBURGH: M. C. Griffith

MEMBER-AT-LARGE: M. E. Blumberg

Suspensions

CHICAGO: R. Schub, H. S. Walkup

LOUISVILLE: John Holton

WATERBURY: Joseph Fazi

Deaths

MEMBER-AT-LARGE: Dr. N. Thon

Membership Competition

BRANCH	Membership Apr. 1, 1953*	New Members	Net Change in Membership	Per Cent Net Change
First Group				
Los Angeles	236	23	+16½	+ 7.0
Melbourne	169	12	+ 7	+ 4.1
Milwaukee	164	6	+ 5½	+ 3.4
Newark	251	7	+ 6½	+ 2.6
Cleveland	236	8	+ 6	+ 2.5
Philadelphia	198	10	+ 4½	+ 2.3
New York†	352	16	+ 6	+ 1.7
Chicago	477	13	+ 8	+ 1.7
Detroit	504	11	+ 8	+ 1.6
Pittsburgh	142	3	+ 1	+ 0.7
Toronto	146	2	+ 1	+ 0.7
Boston	155	..	.....	.....
Bridgeport	158	..	.....	.....
Grand Rapids	173	..	− 1	− 0.6
Waterbury	130	5	− 1	− 0.8
Hartford	151	3	− 3½	− 2.3
Second Group				
Baltimore-Washington	93	7	+ 5½	+ 7.9
Montreal	80	5	+ 5	+ 6.3
San Francisco	74	8	+ 4	+ 5.4
Dayton	76	6	+ 3½	+ 4.6
St. Joseph Valley	78	3	+ 2	+ 2.6
Rochester	107	4	+ 2½	+ 2.3
Saginaw Valley‡	103	5	+ 2	+ 1.9
Providence-Attleboro	95	1	0	0
St. Louis	109	3	0	0
Twin City	71	1	0	0
Buffalo	106	1	− 1	− 0.9
Indianapolis	105	..	− 1	− 1.0
Cincinnati	92	3	− 3½	− 3.8
Syracuse	128	4	− 7	− 5.5
New Haven	100	..	− 5½	− 5.5
Sydney	82	..	−10	−12.2
Third Group				
Springfield	57	7	+ 7	+12.3
Wichita	41	3	+ 3	+ 7.3
Western Ontario	22	1	+ 1	+ 4.5
Rockford	63	2	+ 2	+ 3.2
Columbus	52	1	+ ½	+ 1.0
Adelaide	52	2	0	0
Southeastern	50	2	0	0
Dallas-Fort Worth	53	..	.....	.....
Hamilton	25	..	.....	.....
Houston	42	..	.....	.....
Jackson-Lansing	61	..	.....	.....
Lancaster	69	..	.....	.....
Toledo	56	1	− 1	− 1.8
Kansas City	46	2	− 2	− 4.3
Louisville§	44	..	− 2	− 4.5
Allentown-Reading	53	..	− 4	− 7.5
Outside Competition				
Portland	....	18	.....	.....
At Large	138	11	+ 8	.....
Total A. E. S.	6,065	220	+91½	+ 0.15
Active Membership, July 31, 1953	6,188			

*Subject to correction. †‡§Winners in first, second and third groups, respectively of 1952–1953 membership competition.

J.C. MILLER COMPANY

World's largest producers of *TRIPOLI BUFFING COMPOUNDS* . . . scientifically controlled from mines to finished product

SOURCE and MODERN PRODUCTION

Combine to supply you with the world's finest, most widely used line of buffing compounds

J. C. Miller Company

Due to the increased demand for both bar and liquid buffing compounds, the J. C. Miller Company has just completed new facilities for unlimited production. Now more and more manufacturers everywhere can be assured of receiving prompt delivery on their compound requirements; technical assistance and data from one of the nation's most completely equipped and staffed laboratories.

Liquimatic

LIQUID BUFFING COMPOUND

LIQUIMATIC . . .

THE Liquid Buffing Compound

J. C. Miller Engineers are fully qualified through technical training and years of practical experience to demonstrate and recommend materials and methods for use in your plant — materials and methods that pay you big dividends in higher production and increased savings.

Our Buffing Engineers are equipped with portable Liquimatic demonstration kits which enable them to easily show you the savings that Liquimatic can effect in your plant — on your production line. This demonstration equipment is rapidly set up, requires no assistance from your help and the test can be made on hand lathes or automatic equipment using just a compressed air connection. The demonstration in no way impedes your normal production flow.

Here is a demonstration you should see regardless of past experience or whether or not you are using a liquid compound at present! We know that we can show you that we have achieved the maximum in performance through combining the very latest in equipment with the very best in compounds — Liquimatic. *This is the Liquimatic team — an unbeatable combination.*

Users of Tripoli powder the world over obtain their supply from the American Tripoli Corporation in Seneca, Missouri, where the only known deposit of this unusual material is located. A few of it's many users include manufacturers of buffing compositions, lacquer finishing compounds, automobile polishes, insecticides, etc. Perhaps you have a place for Seneca Standard Tripoli in your process. *Investigate its possibilities!*

EXTRUDED BAR COMPOUND

The J. C. Miller Company offers a complete range of all sizes and shapes of extruded tripoli bar compound. These extruded bars meet all the requirements and conditions of any job — large or small. Write for complete details.

"Seneca Standard" Tripoli is processed in Seneca, Missouri, U.S.A., and is used in all the leading industrial countries of the world.

AMERICAN TRIPOLI CORPORATION
SENECA, MISSOURI, U. S. A.

A Subsidiary of

Tripoli Stainless steel compound Lime finish
Cut and color Chrome rouge Greaseless
Grease stick Emery cake Burring compounds

Controlled Compounds for all Finishing Requirements

J. C. MILLER COMPANY — Grand Rapids, Michigan

For a plastisol rack coating that meets all your requirements...

USE Chem-O-Sol (plastisol formulation)

As one of the early producers of plastisol coatings for the plating industry, we have regularly improved our Chem-O-Sol (plastisol coating) to keep pace with your current needs. Latest development is a Chem-O-Sol specially formulated for superior resistance to chlorinated degreasing solvents.

All Chem-O-Sol coatings have exceptionally good heat and chemical resistance. They are tough coatings — made to stand up day after day under difficult conditions. And, of course, they never contaminate commercial plating solutions.

HAVE YOU INVESTIGATED CHEM-O-SOL? If not, write for free sample and technical details at no obligation. Make sure *you* are using the latest, improved coatings for your job requirements.

Chemical Products Corporation

Formulators of lacquers, coatings, and finishes you can depend on!

105 KING PHILIP ROAD, EAST PROVIDENCE, R. I.

USE READER SERVICE CARD; INDICATE A 1077.

"EMPTY YOUR PURSE

into your head and no man can take it away from you. An investment in knowledge always pays the best interest." That's what wise old Ben Franklin said in 1753. It's just as true in 1953. You'll find that ELECTROPLATING KNOW HOW training continually repays the nominal investment you make in acquiring it. Write today for details without obligation. Joseph B. Kushner, Electroplating School, 115 Broad St., Stroudsburg 2P, Penna.

USE READER SERVICE CARD; INDICATE A 1078.

PERIODIC-REVERSE UNITS

Of the Finest Quality for

PLATING

In the Modern Way

Write for Information

UNIT PROCESS ASSEMBLIES, Inc.

75 East 4th St. New York 3, N. Y.

USE READER SERVICE CARD; INDICATE A 1079.

Directory of A. E. S. Officers and Research Chairman Branch Secretaries and Research Chairmen

A. E. S. OFFICERS

President.....Dr. G. P. SWIFT
53 Galen Street, Watertown 72, Mass.

First Vice-President.....Dr. R. A. SCHAEFER
Cleveland Graphite Bronze Company
17000 St. Clair Avenue, Cleveland 10, Ohio

Second Vice-President.....CLYDE KELLY
1519 Warren Boulevard, Chicago 7, Ill.

Third Vice-President....DR. SAMUEL HEIMAN
Philadelphia Rust Proof Company
3221 Frankford Avenue, Philadelphia 34, Pa.

Past President.....F. J. MacSTOKER
Farrand Optical Company, Inc.
4401 Bronx Boulevard, Bronx, N. Y.

Executive Secretary.....P. PETER KOVATIS
445 Broad Street, Newark, N. J.

A. E. S. RESEARCH COMMITTEE

Chairman.....Dr. Earl J. Serfass
Lehigh University, Bethlehem, Pa.
Secretary.....The Executive Secretary

A. E. S. BRANCHES (Changes only)

BUFFALO meets first Friday of each month in Markeen Hotel. Secretary, Eric G. Sampson, Jr., 43 W. Main Street, Falconer, N. Y.

PRICED TO SELL!

MOTOR GENERATORS Reliably Rebuilt 1 Year Guarantee

6/12 V.
1—10,000 A. HVW 2½/10 V.
1—10,000 A. J-L 2½/10 V.
1— 7500 A. North. 2½/10 V.
1— 5000 A. HVW 6/12 V.
1— 2500 A. Chandey. 6/12 V.
1— 1500 A. HVW 6/12 V.
1— 800 A. HVW 6/12 V.
1— 600 A. Eager 6/12 V.
1— 500 A. Chandey. 12 V
1— 300 A. Hobart 6 V.
1— 200 A. Boissier 6 V.
1— 200 A. U. S. 12 V.
1— 150 A. HVW 6 V.
3— 125 A. Hobart 6 V.
1— 120 A. Eager 7½/15 V.
1— 100 A. HVW 6 V.

15 to 28 V.
1—1000 A. G. E. 15 V.
4— 25 A. Diehl 25 V.
2— 100 A. G. E. 28 V.
1— 200 A. West. 28 V.
1— 500 A. G. E. 28 V.
1— 800 A. G. E. 28 V.
1—1500 A. Cent. 28 V.
1—2500 A. Cent. 28 V.

30 to 60 V.
1— 100 A. G. E. 32 V.
1— 200 A. West. 32 V.
1—1000 A. Cent. 32 V.
1—1000 A. Chandey. 40 V.
1—1250 A. Cent. 45 V.
1— 75 A. G. E. 50 V.
1— 325 A. West. 50 V.
1—1500 A. G. E. 50 V.
1—1000 A. G. E. 60 V.
1—1000 A. G. E. 75 V.

L. J. LAND, Incorporated
136 Grand Street, New York 13, N. Y. CAnal 6-6976
Established 1910

USE READER SERVICE CARD; INDICATE A 1080.

STUTZ PLATING BARRELS

OF HIGH TEMPERATURE LUCITE!

for:

- Heavy Duty Production
- Highest Possible Current
- Complete Cycle—all solutions
  (temperature to 185°F)

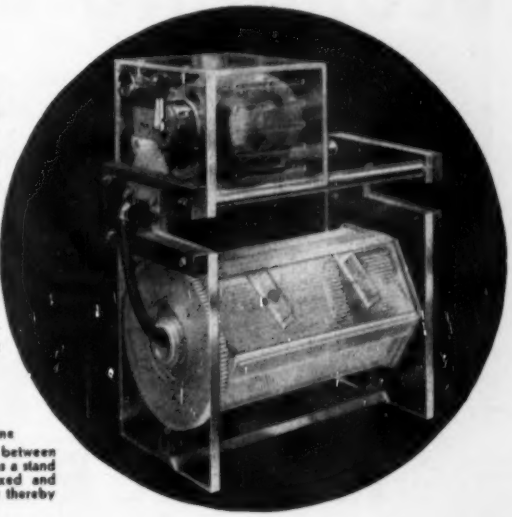
Stutz Plating Barrel Unit for continuous operation through Alkali Cleaning, Acid Pickling, Acid and Alkaline Plating solutions and rinsing. Largest number of cylinder perforations possible.

Stutz Plating Barrel Unit, Motor Drive Mounted Overhead. Continuous rotation of cylinder from one operation to another and where a minimum of solution dragout is important. Roller bearing chain drive to absorb load shock. On a complete Barrel Plating installation, this type of equipment can be made at lower cost since motor drives are not required on each tank station.

Where extremely small openings are required, our patented Dual Hole is used. This design permits solution flow with a minimum of resistance.

The Stutz Portable Plating Barrel

The Stutz Portable Plating Barrel—designed to provide continuous processing of piece parts through the operations of Alkali Cleaning, Water Rinsing, Acid Treatment and Plating. Progression through these operations is made by manual handling or if necessary with the assist of an overhead traveling hoist. (Hoist attachment available.) The Stutz Portable Plating Barrel is made in 2 standard sizes with cylinders having inside dimensions of 6" x 12" and 8" x 18". Special sizes smaller or larger, and with partitions if necessary can be provided. Standard perforations are 3/32" or larger. Smaller openings can be furnished as required. Operating temperature up to 185° F.



Write for our new Illustrated Literature Showing This and Other Design Arrangements.

Specify whether interested in portable or large unit.

Illustrated: Design Number One
Cylinder suspended and rotated between heavy side frames designed to serve as a stand support. Side frames are firmly fixed and further braced with a bottom tie bar thereby providing rigid bearing stability.

GEORGE A. STUTZ Manufacturing Co., 1643 Carroll Avenue, Chicago 12, Illinois

"Complete metal finishing equipment and supplies"

The

BEGINNING of GOOD PLATING

UNEVEN corrosion and release of foreign matter and excessive "sludge" militate against, often prevent, formation of an even, integrated plate of good color. Such "little foxes" are more or less traceable to imperfect grain structure in the anode. Seymour "Controlled Grain" Nickel Anodes give even deposit because the grain is homogeneous. To attain this, virgin nickel is melted in modern electric furnaces and poured under accurate analytical and pyrometric control. As a result, Seymour Anodes corrode evenly, eliminating many a plater's headache!

SEYMOUR
NICKEL ANODES

The Seymour Manufacturing Company, Seymour, Conn.

Index to Advertisers

ACME FISHER COMPANY 1033
Agency: Mullican Co.
ALLIED RESEARCH PRODUCTS, INC. 960
Agency: Emery Advertising Corp.
ALMCO DIV., QUEEN STOVE WORKS, INC. 1031
Agency: Weston-Barnett, Inc.
ALSOP ENGINEERING CORPORATION 1041
AMERICAN BUFF COMPANY 1016
Agency: Burlingame-Grossman, Adv.
AMERICAN CHEMICAL PAINT CO. 976
Agency: May Advertising Company
AUTOMOTIVE RUBBER COMPANY, INC. 965
Agency: Zelsy & Associates

BACON FELT COMPANY 1038
Agency: Sanger-Funnell, Inc.
M. E. BAKER COMPANY 1019
BART-MESSING CORPORATION 968
Agency: Bass & Company, Inc.
BEAM-KNODEL COMPANY 1028
BEHR-MANNING CORPORATION 949
Agency: Peterson & Kempner, Inc.
BELKE MANUFACTURING COMPANY 961
Agency: Allbright Associates
BETTER FINISHES & COATINGS, INC. 966
Agency: James J. McMahon, Inc.

CEILCOTE COMPANY 1031
Agency: Carpenter Advertising Company
THE CHEMICAL CORPORATION 1020
Agency: Wm. B. Remington, Inc.
CHEMICAL PRODUCTS CORP. 1048
Agency: Geo. T. Metcalf Company
CHEMSTEEL CONSTRUCTION CO., INC. 1028
Agency: Smith, Taylor & Jenkins, Inc.
COLUMBIA ELECTRIC MANUFACTURING CO. 962
Agency: Meermans, Inc.
CRO-PLATE CO. 1034
Agency: Fairbairn & Co., Inc.
CROWN RHEOSTAT & SUPPLY COMPANY 1045
Agency: Saunders, Shrout & Associates, Inc.

DAVIES SUPPLY & MANUFACTURING CO. 1021
Agency: Batz-Hodgson-Neuwoehner Adv. Agency
DIAMOND ALKALI COMPANY 997
Agency: Fuller, Smith & Ross
THE DIVERSEY CORPORATION 1052
Agency: Russel Seeds Company
DUGGAN MASKING DEVICES 1016
Agency: A. R. Brash & Sons
DU-LITE CHEMICAL CORPORATION 1019
Agency: Charles Palm & Company
DU PONT DE NEMOURS, E. I., & CO., INC. 1017
Agency: Batten, Barton, Durstine & Osborn, Inc.

ENTHONE, INCORPORATED 947
Agency: Hugh H. Graham & Associates, Inc.

FEDERATED METALS DIV., AMERICAN SMELTING & REFINING CORPORATION 948
Agency: John Mather Lupton Co., Inc.
FIDELITY CHEMICAL PRODUCTS CO. 1044
Agency: Art Copy Advertising Agency
FORMAX MANUFACTURING COMPANY 962
Agency: Brindley-Roth, Inc.

GENERAL ELECTRIC COMPANY 1029
Agency: G. M. Basford Company
W. GREEN ELECTRIC COMPANY 998-999
Agency: Shappe-Wilkes, Inc.
FREDERICK GUMM CHEMICAL CO., INC. ..... 2nd Cover
Agency: Schniedenbach Studios

HAMMOND MACHINERY BUILDERS, INC. 971
HANSON-VAN WINKLE-MUNNING CO. ..... 1000, 4th Cover
Agency: O. S. Tyson & Company, Inc.
HARDWOOD LINE MFG. CO. 1032
Agency: Thomas Thomas
THE HARSHAW CHEMICAL COMPANY 980
HAVEG CORP. 975
Agency: Geare-Marston, Inc.
R. O. HULL & COMPANY, INC. 1037
Agency: Ralph M. French Advertising

KOCOUR COMPANY 954
Agency: DeCasseres & Associates
JOSEPH B. KUSHNER 1048

LAND, L. J., INC. 1048
THE LEA MANUFACTURING COMPANY 1030
Agency: Sanger-Funnell, Inc.
CHARLES F. L'HOMMEDIEU & SONS COMPANY 953

MAC DERMID, INCORPORATED ..... 3rd Cover
Agency: Jackson Hall Company
MAGNUS CHEMICAL COMPANY 1024
Agency: Spooner & Kriegel
MAGNUSON PRODUCTS CORPORATION 963
Agency: Asher, Godfrey & Franklin, Inc.
THE MEAKER COMPANY 964
Agency: Merrill, McEnroe & Assoc., Inc.
MICHIGAN BUFF CO., INC. 1031
MICHIGAN CHROME & CHEMICAL CO. 1027
Agency: Karl G. Behr
J. C. MILLER 1047
Agency: James Philip Reed
MINNESOTA MINING & MFG. COMPANY 956
Agency: Batten, Barton, Durstine & Osborn, Inc.
MUNRAY PRODUCTS, INC. 1043
Agency: Kenneth H. Kolpien
MUTUAL CHEMICAL CO. OF AMERICA 1018
Agency: The House of J. Hayden Twiss

NANKERVIS COMPANY, GEORGE L. 973
Agency: Charles M. Gray & Associates
NATIONAL RACK COMPANY 970
Agency: John Philips Advertising Company
NOBLES ENGINEERING & MFG. COMPANY 957
Agency: E. W. Sann & Associates
NORTHWEST CHEMICAL COMPANY 977
Agency: F. B. Hubert Advertising Counsel
KARL NUSSBAUM & SONS, INC. 1026

OAKITE PRODUCTS, INC. 1040
Agency: Rickard & Company

PATENT BUTTON COMPANY 1020
Agency: Edward Graceman & Associates
PENNSYLVANIA SALT MFG. COMPANY 967
Agency: Geare-Marston, Inc.
PROMAT DIV., POOR & COMPANY 969
Agency: Russell T. Gray, Inc.

SARCO COMPANY, INC. 1026
Agency: Gus Binz Associates
SCHAFFNER MANUFACTURING CO., INC. 972, 1052
Agency: Advance Advertising Company
E. E. SEELEY COMPANY, INC. 1033
SEL-REX PRECIOUS METALS, INC. 955
Agency: Bass & Company, Inc.
SELLERS ENGINEERING COMPANY 1040
Agency: Simmonds & Simmonds, Inc.
SETHCO 1028
THE SEYMOUR MANUFACTURING CO. 1050
Agency: Claude Schaffner Advertising Agency
SPARKLER MANUFACTURING COMPANY 952
Agency: Kreicker & Meloan, Inc.
STANDARD RESEARCH 1026
Agency: Peck Bros., Adv.
STEVENS, FREDERIC B., INC. 978
Agency: Grant Advertising, Inc.
STORTS WELDING COMPANY, INC. 1018
Agency: Harold S. Card
STUTZ, GEORGE A., MFG. COMPANY 1049
Agency: Sander Rodkin Adv. Agency, Ltd.
SULPHUR PRODUCTS COMPANY, INC. 1034

TRUE BRITE CHEMICAL PRODUCTS CO. 974

THE UDYLITE CORPORATION 958-959
Agency: Grant Advertising, Inc.
UNIT PROCESS ASSEMBLIES, INC. 1048
Agency: State Advertising Service
UNITED CHROMIUM, INCORPORATED 1039
Agency: Rickard & Company, Inc.

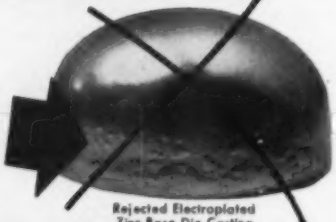
WAGNER BROTHERS, INC. 1022-1023
Agency: Fred P. Bingham, Technical Advertising
WILLIAMSVILLE BUFF DIV., BULLARD CLARK COMPANY 1025
Agency: Gordon Schonfarber & Associates, Inc.
WYANDOTTE CHEMICALS CORPORATION 950-951
Agency: Brooke, Smith, French & Dorrance, Inc.

You're Twice as sure

WITH THESE TWO GREAT CLEANERS!

DIVERSEY
No. 505
ELECTROCLEANER and SURFACE CONDITIONER

ELIMINATE BLISTERING AND STREAKING



Rejected Electroplated Zinc Base Die Casting

DIVERSEY
No. 909
HEAVY-DUTY SOAK TANK CLEANER

• You can depend on Diversey No. 505 and No. 909 to help you produce bright, blemish-free, adherent surfaces on zinc base die castings . . . prevent blistering and streaking caused by insufficient cleaning.

Diversey No. 909 is an unique heavy duty soak tank cleaner . . . non-caustic yet exceptionally powerful . . . can eliminate solvent presoak operation . . . now *one* pre-cleaning step instead of two . . . saves time and money . . . cleans thoroughly safely!

Diversey No. 505 is an amazing electrocleaner and surface conditioner made especially for cleaning zinc base die castings . . . cleans thoroughly and prevents redeposit of soil on work . . . conditions the surface, providing better adhesion between electroplate and base metal!

Start now to profit from efficient, economical, carefree cleaning! WRITE FOR FREE BULLETINS ON DIVERSEY NO. 505 AND DIVERSEY NO. 909!

THE DIVERSEY CORPORATION

Metal Industry Department

1820 Roscoe St. • Chicago 13, Illinois

In Canada: The Diversey Corporation (Canada) Ltd.
Lakeshore Road, Port Credit, Ontario

Future Meetings

124TH NATIONAL MEETING—AMERICAN CHEMICAL SOCIETY, September 6–11, 1953 in Los Angeles, Calif.

104TH MEETING OF THE ELECTROCHEMICAL SOCIETY at the Ocean Terrace Hotel, Wrightsville Beach, N. C., September 13–16, 1953.

1953 SEMI-ANNUAL MEETING OF THE AMERICAN HOT DIP GALVANIZERS ASSOCIATION at the Statler Hotel, Cleveland, Ohio, September 14–15, 1953.

EIGHTH NATIONAL INSTRUMENT EXHIBIT under the sponsorship of the Instrument Society of America at the Sherman Hotel, Chicago, Ill., September 21–25, 1953.

35TH NATIONAL METAL EXPOSITION AND CONGRESS under the sponsorship of the American Society for Metals, October 19–23, 1953 at the Cleveland Public Auditorium.

INDUSTRIAL PACKAGING AND MATERIALS HANDLING EXPOSITION at Boston Mechanics Building, October 20–22, 1953.

Schaffner brings you

Another First FREE

Schaffner's new Buff 'n Polish Calculator gives the answers to all your buffing problems! It shows the proper compound, buff and SFPM required to achieve any finish on any material. There's no need to experiment when you get special jobs involving unfamiliar materials if you have a Buff 'n Polish Calculator. Fill out the coupon to obtain yours today!!

Clip To Your Letterhead

Schaffner manufacturing company, inc.
SCHAFFNER CENTER, EMSWORTH, PITTSBURGH 2, PA.

Please send a Buff 'n Polish Calculator to:

Name _____
Title _____
Company _____
Street _____
City _____ Zone _____ State _____

Schaffner
manufacturing company, inc.

Observed 1-1902

SCHAFFNER CENTER, EMSWORTH, PITTSBURGH 2, PA.

METEX

CARBON and PAINT REMOVER #T280

New, non-corrosive, water rinsable, liquid tank type organic compound for removing carbon and other soil from small engine parts such as pistons or connecting rods, or heavy accumulations of grease and soil from miscellaneous parts, and for complete removal of paint in tank type operations.

METEX Carbon & Paint Remover T-280 is specially recommended for . . .

Removing carbon, paint and heavy soil accumulations from internal combustion or jet engines and engine parts and stripping paint from rejected parts where tank type operations are adaptable.

Meets A A F specifications #20043.

METEX

CLEANER TS-40A

Recommended for:

- Cleaning prior to painting, anodizing aluminum, spot welding.
- Removing stenciling inks from aluminum.
- As a soak cleaner prior to electrocleaning.
- Cleaning multi-alloy assemblies, such as engines, bearings, etc.
- Special applications in burnishing.
- Fabrication operations where a variety of metals are cleaned in the same tank.

Be sure to write for full information on this versatile and efficient all-purpose immersion cleaner for light metals, aluminum, copper, brass, zinc, lead, and ferrous metals.

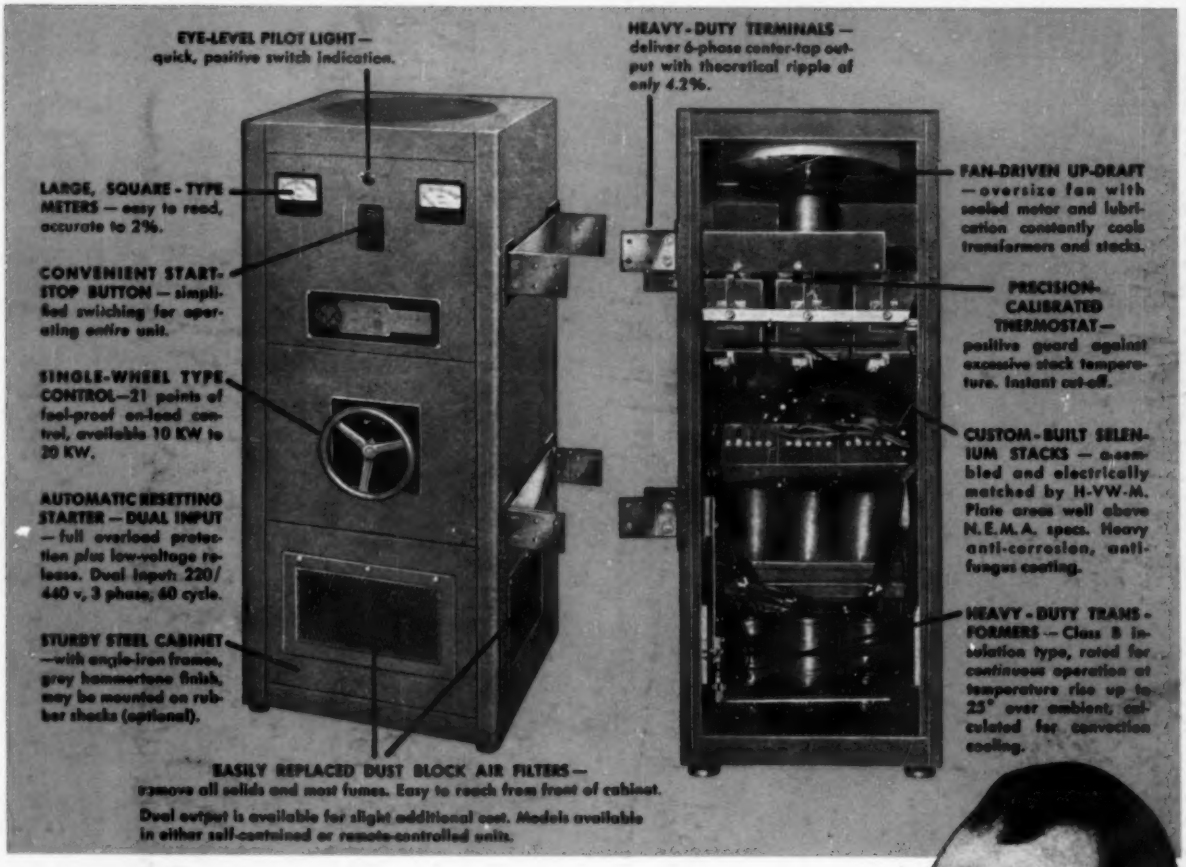
Meets latest Interim Federal and U. S. Army specifications, PC 436.

MAC DERMID
Incorporated
WATERBURY 20, CONNECTICUT

FOR 31 YEARS *Originators* FOR THE METAL FINISHING INDUSTRY

NEW H-VW-M HEAVY-DUTY *Rectifiers*

combine all these features most desired for metal finishing operations


EYE-LEVEL PILOT LIGHT— quick, positive switch indication.
HEAVY-DUTY TERMINALS — deliver 6-phase center-tap output with theoretical ripple of only 4.2%.
LARGE, SQUARE-TYPE METERS — easy to read, accurate to 2%.
CONVENIENT START-STOP BUTTON — simplified switching for operating entire unit.
SINGLE-WHEEL TYPE CONTROL—21 points of fool-proof on-load control, available 10 KW to 20 KW.
AUTOMATIC RESETTING STARTER — DUAL INPUT — full overload protection plus low-voltage release. Dual input: 220/440 v, 3 phase, 60 cycle.
STURDY STEEL CABINET —with angle-iron frames, grey hammertone finish, may be mounted on rubber shocks (optional).
FAN-DRIVEN UP-DRAFT — oversize fan with sealed motor and lubrication constantly cools transformers and stacks.
PRECISION-CALIBRATED THERMOSTAT — positive guard against excessive stack temperature. Instant cut-off.
CUSTOM-BUILT SELENIUM STACKS — assembled and electrically matched by H-VW-M. Plate areas well above N.E.M.A. specs. Heavy anti-corrosion, anti-fungus coating.
HEAVY-DUTY TRANSFORMERS — Class B insulation type, rated for continuous operation at temperature rise up to 25° over ambient, calculated for convection cooling.
EASILY REPLACED DUST BLOCK AIR FILTERS — remove all solids and most fumes. Easy to reach from front of cabinet.
Dual output is available for slight additional cost. Models available in either self-contained or remote-controlled units.

Imagine... a theoretical ripple of *only 4.2%*. There's real assurance of more uniform deposits! And single-wheel control... only one control for 21 points of on-load switching! And those *oversize* transformers for plenty of reserve capacity—as well as the *increased plate area*... all these, plus the individual features pointed out above, add up to the most complete line of rectifiers ever designed for metal finishing. *Yet they cost less per unit than any other rectifiers made!*

For complete information on H-VW-M Rectifiers ask for Bulletin ER-105.

Your H-VW-M combination—of the most modern testing and development laboratory—of over 80 years experience in every phase of plating and polishing—of a complete equipment, process and supply line for every need.

HANSON-VAN WINKLE-MUNNING CO., MATAWAN, N. J.

PLANTS AT: MATAWAN, N. J. • ANDERSON, INDIANA
SALES OFFICES: ANDERSON • BALTIMORE • BOSTON CHICAGO • CLEVELAND • DAYTON • DETROIT • GRAND RAPIDS • LOS ANGELES • LOUISVILLE • MATAWAN MILWAUKEE • NEW YORK • PHILADELPHIA • PITTSBURGH ROCHESTER • SPRINGFIELD (MASS.) • STRATFORD (CONN.) UTICA • WALLINGFORD (CONN.)

H-VW-M

INDUSTRY'S WORKSHOP FOR THE FINEST IN PLATING AND POLISHING PROCESSES · EQUIPMENT · SUPPLIES

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1086.